With the Author's Compliments & kind Regards to
Dr. H. B. Donkin.
Wednesday, Nov. 13th, 1889.

THE

DISEASES AND DISORDERS OF THE OX.

THE

DISEASES AND DISORDERS

OF

THE OX.

WITH SOME ACCOUNT OF THE DISEASES OF THE SHEEP.

BY

GEORGE GRESSWELL,

RECENTLY LECTURER IN PHYSICAL SCIENCE AT THE DIOCESAN COLLEGE NEAR CAPE TOWN;
AUTHOR OF "AN EXAMINATION OF THE THEORY OF EVOLUTION,"
AND OF OTHER WORKS.

WITH ADDITIONS ON HUMAN AND COMPARATIVE PATHOLOGY

BY

DR. ALBERT GRESSWELL.

LONDON:
W. H. ALLEN & CO., 13 WATERLOO PLACE. S.W.

1889.

"All truth is precious, if not all divine,
And what dilates the pow'rs must needs refine."

—Cowper.

PREFACE.

Now at length we have completed the task we set before us, and we have great pleasure in offering to our kind friends the public the final outcome of our work and the enterprise of our publishers in the shape of the volume which now lies before the reader.

The ox is of use to mankind in several different ways. Indeed, the relations in which that animal stands to human beings are very numerous, and we have not been able to discuss any of them thoroughly in the pages which follow. The chief point we have tried to insist upon is the fact that the diseases and disorders which afflict human beings are causally connected with those of lower animals, and of these in a high degree with the maladies of oxen, in various important ways. In proportion as the Science of Pathology advances, the numerous and intricate connections which subsist betwixt the diseases of man and those of animals will in all probability be seen to be much more intimately allied than we can at present understand. By way of example, it may be mentioned that it is impossible to over-estimate the far-reaching importance of the discovery of Dr. Klein and Mr. Power that

human scarlet-fever may be derived from a disease afflicting cows. Indeed, the announcement of this fact and of the facts on which it is founded was received by the scientific world as a revelation of a startling kind, and as one of the greatest importance.

Those who can understand the advances which have been recently made in science, and in the field of Pathology in particular, cannot but feel rejoiced at the prospect in store for those who will come after us. As each year pursues its course, our knowledge of diseases, of medicines, and of therapeutic appliances becomes more wide; and it should not be forgotten that facts and principles derived from the study of maladies as they are manifested by the lower animals, have even already affected the art and science of human medicine and surgery, and must still more importantly influence them in the future. There can be no doubt that, in proportion as microscopical methods advance in perfection, we shall learn more and more concerning the relations which subsist betwixt human diseases and those which afflict animals. It is possible we may find that there is a much more far-reaching interaction between those disorders which afflict man and those of the animals which he has domesticated, than we can now form any conception of. If this is so, the clue is certainly one of the utmost value.

Hence it is obviously very important that the diseases of animals should be well managed, and that the whole subject of sanitary science in relation to animals should be thoroughly attended to. Especially is this necessity manifest, when we consider that plagues of different kinds among animals very frequently break out. It is well known that the ancient records, both of Scriptural and of Pagan history, repeatedly mention the occurrence of epidemics among cattle. We read that in the time of Moses the cattle of Egypt were decimated by the "murrain," and that all kinds of animals died in con-

sequence thereof. Indeed, epizoötic disorders have attracted the attention of the historians of all nations. For example, Homer, who flourished about 900 years before the Christian era, alludes to these visitations; and, moreover, Virgil writes:—

> On winter seas we fewer storms behold
> Than foul diseases that infect the fold.
> Nor do these ills on single bodies prey,
> But oft'ner bring the nation to decay,
> And sweep the present stock and future hope away.
> A dire example of this truth appears
> When, after such a length of rolling years,
> We see the naked Alps and their remains
> Of scattered cots and yet unpeopled plains,
> Once fill'd with grazing flocks, the shepherd's happy reigns.
> Here, from the vicious air and sickly skies,
> A plague did on the dumb creation rise;
> During the autumnal heats the infection grew,
> Tame cattle and the beasts of nature slew.
>
> . . . . .
>
> Sheep, oxen, horses fell, and, heaped on high,
> The diff'ring species in confusion lie.
>
> *Georgic* iii., 1, 711-829, Dryden's translation.

The above doubtless refers to an epizoötic raging among the Alps, probably not less than 2,000 years ago.

Again, Plutarch narrates how in the days of Romulus, about the time that Rome was founded, viz. 750 B.C., a great plague, after destroying the fruits of the earth and the cattle, swept off many of the people; and Livy writes that "the consuls had the greater difficulty to raise their recruits, because the plague, which the year before had raged among horned cattle, broke out among men."

Turning now our attention to these present times; as is well known, we find that in recent years men have been made very familiar indeed with outbreaks of disastrous diseases among animals, and some of these—canine rabies more especially—have attracted the most earnest research. Anthrax also has

been thoroughly investigated, and likewise many other maladies have been carefully studied.

In the following pages we treat more particularly of the diseases and disorders of the ox and sheep ; but now and again we have discussed our subjects from a more general aspect. We may say here, what we shall afterwards have occasion to say again, that the maladies with which the sheep is liable to be afflicted are of vastly greater importance than is often recognised, and that a great deal of wealth might be saved by thoroughly careful management of sheep. In so far as we may have cleared up any obscure points connected with the disorders of sheep, we feel pleasure in the achievement of our purpose in this respect. Our readers will see a great resemblance betwixt the diseases of cattle and those of sheep, and hence it would have been a pity to have omitted the latter.

The very fullest possible acknowledgment is due, and is hereby made, for the kindly aid and unremitting help and encouragement of Dr. Albert Gresswell, whose part in the production of this book is also stated on the title-page. Without his assistance the work could not have been carried through to completion.

Another brother, Dr. D. Astley Gresswell, has kindly read through the proof sheets of this work, as it has passed through the press. He has corrected certain errors, has rectified several inaccuracies, and made valuable improvements and additions.

To Mr. James Brodie Gresswell, F.R.C.V.S., the authors are also grateful for certain notes supplied, also for verbal information now and again made use of—for instance, of cases of disease in stock to which this distinguished veterinarian has been summoned, diseases which have been met with in the

course of the extensive and well-managed veterinary practice carried on by him at Louth, in Lincolnshire, as a centre.

It remains to be added that very much of the information contained in this work has been derived from the authors' father, the late Mr. Alderman Dan Gresswell, F.R.C.V.S., whose long and honourable connection with Science, as one of her most persevering, enthusiastic, and successful votaries, is known throughout the world.

Suggestions are thankfully acknowledged from other brothers, namely, the Rev. Henry William Gresswell, M.A., Oxon; Mr. Charles Gresswell, late Deputy-Examiner for the Royal College of Veterinary Surgeons; Mr. Edmund Gresswell; and Mr. Samuel Gresswell. It may truly be said that much of the work contained in these pages is original, and that the book as a whole represents the work of years of study and research.

The account of the Ligaments and Muscles has been abstracted from Strangeways' *Veterinary Anatomy*, revised by I. Vaughan, F.L.S., F.Z.S., which book has also been referred to for some other information here and there in the account of the Anatomy of Ruminants.

We are very grateful to Dr. Klein and Professor Simonds for allowing us to use several illustrations, and also to Mr. Armatage, the Royal Agricultural Society, Messrs. J. & A. Churchill, Messrs. Macmillan & Co., Messrs. Clowes & Sons, the Editor of *The Yorkshire Post*, and Messrs. Arnold & Sons, for likewise giving us similar permission.

One of the chief remarks by way of acknowledgment, which we have much pleasure in making, is that portions of what is contained in this book originally appeared in that valuable journal, *The Yorkshire Weekly Post*.

DR. E. KLEIN'S *Micro-organisms and Disease.* London: Macmillan & Co. 1886. Illustrations have been taken by permission from this work.

STRANGEWAY'S *Veterinary Anatomy.* Third Edition. Revised and Edited by J. VAUGHAN, F.L.S., F.Z.S. Edinburgh: Bell & Bradfute. 1886.

The Cattle Plague. By JOHN GAMGEE. London: Robert Hardwicke. 1866.

WOOD'S *Bible Animals.* London: Longmans, Green & Co.

The Cow and Calf. By JOHN WALKER. London: Thomas C. Jack, 45, Ludgate Hill. 1886.

The Sheep and Lamb. By the same Author. London: Thomas C. Jack, 45, Ludgate Hill.

Aide-Mémoire du Vétérinaire. By J. SIGNOL. Paris: Baillière 1884.

Supplements containing Report of the Medical Officer to the 15th and 16th Annual Reports of the Local Government Board 1885–86 and 1886–87. Four plates illustrating Dr. Klein's work have been copied from plates in these Supplements.

Diseases of Farm Animals, excepting the Horse. By Principal and Professor G. T. BROWN, C.B., F.R.C.V.S., &c.

A Lecture on the Anatomy and Physiology of the Maternal Organs of Reproduction in Animals, with the Principles of Practice applicable to cases of difficult and Preternatural Labour, more especially in the Cow and Ewe. In accordance with the kind permission of the Royal Agricultural Society and of Professor JAMES BEART SIMONDS, sometime Principal of the Royal Veterinary College, London, the plates illustrating this article (which appeared in the Journal of the Royal Agricultural Society, vol. x. July, 1849, page 248 to 275) have been inserted in the following pages, and some of the article has been borrowed.

Variola Ovina. By Professor SIMONDS. And other works.

LIST OF ILLUSTRATIONS.

—— o ——

CONTENTS.

CHAPTER VII.

CHAPTER VIII.

APPENDIX.

THE DISEASES AND DISORDERS

OF

THE OX.

INTRODUCTION.

"Bacon's prophecies of the advance of science have been fulfilled far beyond what even he could have anticipated. For knowledge partakes of infinity; it widens with our capacities; the higher we mount in it, the vaster and more magnificent are the prospects it stretches out before us. Nor are we in these days, as men are ever apt to imagine of their own times, approaching to the end of them; nor shall we be nearer the end a thousand years hence than we are now. The family of Science has multiplied. New sciences, hitherto unnamed, unthought of, have arisen. The seed which Bacon sowed sprang up and grew to be a mighty tree, and the thoughts of thousands of men came and lodged in its branches, and those branches spread 'so broad and long that in the ground the bended twigs took root, and daughters grew about the mother tree, a pillared shade high over-arched . . . . and echoing walks between' . . . . walks where Poetry may wander and wreathe her blossoms around the mossy stems, and where Religion may hymn the praises of that Wisdom of which Science erects the hundred-aisled temple."—*Anon.*

We take our pen in hand to-day with the hope, and in the belief, that another work on the Diseases and Disorders of the Ox (albeit that there are already good treatises on this subject) will be found to be of great value to English-speaking agriculturists. Notwithstanding that a great deal has been written on the pathology of cattle and sheep, there remain many questions of transcendent interest and importance—many points of doubt and obscurity and misapprehension, some of which we have endeavoured to clear up. Indeed, it is very well known and recognised,

no less by veterinary surgeons than by others who have to do with cattle, that the want of a carefully-written work, dealing with the more general and practical aspects of bovine and ovine medicine and surgery, is widely felt. Yet it is far more easy to realise a deficiency which exists than it is to supply what is lacking, and in this case the difficulties are perhaps exceptionally great. Several causes conduce to the fact that the sciences of therapeutics, surgery, and pathology, in their relation to cattle, are as yet in their infancy. As years roll on, those who have to do with oxen will become more and more deeply convinced that it is frequently advisable to hand over to the care of the veterinary surgeon many cases which are now summarily, and often without due thought, consigned to the butcher's tender mercies. It is, indeed, very clear that a great deal of special skill and practical scientific knowledge is frequently required in order that one may be able to adequately balance the advantages and disadvantages which attach themselves to the alternatives of treatment or slaughter. Evidently it is often of pressing importance to determine when it would be advisable to avoid the risk of a lingering illness or that of a fatal termination, whereby the loss resulting from the carrying out of curative measures may be made twofold. In many cases, too, such points as the risk of spreading infection to other animals in contiguity with those which are suffering, and also the question whether the flesh would, in case of slaughter, be good for human food or not, present themselves for most careful consideration. Of such kind are the difficulties of judgment with which the veterinary surgeon and his employer, the owner, have to grapple, often, too, at very short notice. It is, moreover, clearly manifest that the mutual advantage of both parties interested will be enhanced in proportion as the sciences of medicine and surgery primarily, and those of bovine medicine and surgery specially, advance to greater precision and accuracy. When one considers that whole herds of cattle are liable to be mown down by severe plagues, which may sweep along their terrible course even throughout a whole country, and when one reflects also that certain diseases of man, such as tuberculosis (generally known as consumption), scarlet fever, and others, are traceable in many cases to similar diseases in oxen, it will be seen that the magnitude and importance of the subject we are treating can hardly be over-estimated.

An abundant supply of good meat in the country is one of the greatest desiderata, and any special knowledge which will aid such an indispensable condition of our progress as a nation must be hailed with feelings of relief and rejoicing. Moreover, it is not too much to say that bovine medicine and bovine surgery take a rank quite equal to that of equine medicine and surgery in regard to their influence on one of the most important sciences of the day—that of comparative pathology.

As an illustration of what we have been saying as to the great importance to the country of a thorough knowledge of the diseases of cattle, we may note what Professor John Gamgee, whose work on the *The Cattle Plague* is one of great power, wrote as to the prevention of this dreadful scourge. Of the disease itself we shall have to speak in its right place; but here we may repeat the following remarks taken from the preface of the above-mentioned admirable treatise:—

"The points on whieh I have specially had to contend," he says, "with not a few opponents, were at first the foreign origin of the malady, the impossibility of its spontaneous development in the London dairies, the insufficiency of any remedy or class of remedies, the folly of establishing cattle hospitals or sanatoria, the importance of regulating and controlling the traffic in live stock, stopping all movement when the disease appeared, and prohibiting importation from Holland, or establishing foreign stock-markets and slaughter-houses. I have advocated a system of national insuranee or one of indemnity, of slaughter of the sick and infected animals. I was not in favour of the recommendation of the majority of the Cattle Plague Commissioners, inasmuch as stopping the entire traffie of the country without 'stamping out' the disease could not serve our purpose. A recommendation that Parliament should be at once summoned, that inspectors should continue the practice of slaughtering, backed with funds to indemnify owners—all in addition to stopping the traffic—would, in my opinion have been more rational and less embarrassing to Government than the suggestion whieh eould not be, as indeed it was not, earried into effect."

Thus wrote, in 1866, the man who did so much to suppress the traffic in diseased animals and to secure a rational system for the prevention of disease.

In connection with this same terrible disease—cattle plague—we will quote also the words of Dr. Lionel S. Beale, F.R.S., words which, we may add, are, albeit that great discoveries have since been made, still as applicable, as they were at the time when he wrote, to disease in general:—"Thorough, prolonged, and thoughtful scientific investigation seems now the only course open to us, and that ought to be prosecuted by many, and in earnest."

As to the cause of cattle plague, it may be here incidentally

mentioned that Klebs and Semmer have found the presence of the disease-germs (micrococci) in the blood and lymphatic glands.*

Moreover, in view of the fact that the insidious malady known as "contagious pleuro-pneumonia" is still rife in certain places, it will be seen how important it is to know all that can be learned as to its causation. Of this disease, too, we shall have to speak fully in its proper place; but we may here say that slaughter of affected animals, and of animals supposed to be infected, and disinfection of the contaminated sheds are, so far as can be at present decided, the best means of dealing with this severe cattle scourge.

With regard to pleuro-pneumonia, then, as in the case of all contagious diseases of lower animals, we must lay the greatest emphasis of which we are capable on the method of stamping out by slaughter of all animals affected, or supposed to be affected. That is one point, and a point of immense importance.

Still, however, this disease breaks out again and again, in spite of all that can be said, as a result of the fact that cattle-owners do not grasp the conditions of the problem, and do not carry out either one rational method or another. If for any reason any of the members of an affected herd are not slaughtered, then they should be skilfully inoculated for protective purposes. As a matter of fact, they are in nine cases out of ten neither slaughtered nor inoculated, and the only result which could possibly be expected is that the disease breaks out again and again, and so spreads and spreads like the leaven in the meal.

One of the questions which most nearly concerns the public welfare and the public health is the determination when flesh is good for use as human food. There is no doubt that this point is at times one of some difficulty. It is possible to be too particular; but it is probable that the converse mistake is more usual.

Of the terrors of trichiniasis we need not here speak. They are well known. How important it is that a knowledge of science

* With micrococci of a first cultivation a calf was inoculated by Semmer and Archangelski. After seven days it died of cattle plague. If, however, animals (sheep) are inoculated with later cultivations, *i.e.* with an attenuated virus, they thereby secure an immunity against attacks of virulent cattle plague.

should be more widely diffused is illustrated by the indisputable fact that many people would be far more careful if they knew what risks they run in eating meat which has not been properly cooked. Many of the dangers which are apt to arise might in many cases be avoided if all meat were thoroughly subjected to the purifying thereby ensured. Underdone meat, and especially underdone beef, veal, and pork, are stringently to be avoided. There can be but very little doubt that the abstention from pork on the part of the Jews, as also many other, at first sight, inexplicable customs of different nations, had its origin in matured judgment begotten of experience. It is not at all uncommon to find, on careful scrutiny, that many animals liable to be used for food are infested with tape-worms in different stages of their life-history.

If those who are so fond of dogs as occasionally to indulge in the at first sight apparently harmless but in reality most dangerous habit of allowing them to eat from the platters to be employed afterwards at their own tables, had the barest notion of the results which might therefrom ensue, they would certainly abstain from such folly. They would carefully avoid the dangerous practice of caressing and kissing their pets. If they would read the late Professor Cobbold's most valuable work on helminthology, the eyes of some ladies would certainly be opened in a somewhat startling manner, especially if they knew in what way all the best authorities explain the fact that so many Icelanders are infested with their horrible and uninvited guests. Some people, however, scarcely know there are such things as tape-worms, and certainly only those who have seen patients subjected to their presence can form any idea of the inconvenience and danger resulting from their unwelcome abode inside the human frame.

From these and other considerations it may be seen how very important it is to be able to decide when meat is fit and when unfit for human food.

Before passing on, we may pause to refer briefly to the different contagious diseases of animals which still existed in the country at the end of 1887. We cannot do better than give a short abstract of the observations relating to that subject which appear in that best of papers, *The Times* (which, by the way, we congratulate most sincerely on the recent coming round of

its centenary), in its issue of January 2, in the course of the article which sums up the chief aspects of "British Agriculture in 1887."

We read that in the summer of that year swine fever (thought by some to be connected with typhoid fever of man) was very prevalent, while those two greatly-dreaded scourges, pleuro-pneumonia of oxen, and anthrax (for the most part also afflicting oxen), appeared and re-appeared from time to time. In reference to contagious diseases of animals the most important event of the year 1887 was, perhaps, that which occurred during the Smithfield week. Representatives from all our leading societies waited upon Lord John Manners. They urged that the Privy Council should enforce uniform regulations with respect to these matters, their contention being that not only those animals which are actually afflicted with pleuro-pneumonia and anthrax, but also those which have been in close proximity with animals which are suffering from those maladies, should be summarily slaughtered and carefully buried with antiseptic precautions.

Now we may say here, in reference to the question of the more special investigation of any given outbreak of disease, that it should include, not only a most careful consideration of the place where the affected animals are located, their occupation, the supply of the three requisites, air, food, and water, the characters of the soil, of the herbage, and so forth, as well as all other details of management; but also in addition, in all cases where it may be practicable, the application of the best microscopic methods. At any rate, it is frequently advisable to resort to this mode of inquiry when we are confronted with an infectious or contagious disease, or one suspected to be of such a nature. We may here add that, as a rule, infectious maladies are characterised by a rise of temperature and by the appearance of an eruption, either on the surface of the skin or on one or more of the mucous membranes, or in both situations. One attack of an infectious or contagious disease usually confers an immunity, the degree of which varies very considerably in different diseases. Moreover, these diseases can be produced by introducing the virus into the blood of a susceptible animal. Wherever the infectious disease in question is met with, the particular germs are to be found. Hence it is very obvious that preventive measures must be directed to the destruction of the germs, or to the pre-

vention of their introduction into animals. It is also highly necessary that the strength of the affected animals should also be supported in order that they may thereby rid themselves of the virus of the disease.

Again, it is to be remembered that diseases like rabies, anthrax, cholera, and also snake-poisoning—if we may classify this dreadful mode of death among diseases, and there certainly seems to be some possibility that snake-poisons exercise their astonishingly virulent effects by means of germs—are so swiftly and dreadfully fatal that only those who have seen human beings dying from the results of their ravages can form any adequate conception of their character. So far from attempting to disparage scientific work, all humanitarians ought to join hands in the great cause of science, and encourage one another to advance to more complete knowledge with the greatest enthusiasm and to the utmost of their power. There can be no doubt that the recent outbreak of rabies, which at one time seemed to be likely to extend to a very great extent throughout the country, was put a stop to—although certainly none too soon—by the vigorous action taken by all concerned. The Rabies' Order of 1887 soon arrested the progress of that dread disease. The muzzling of dogs during an outbreak of this scourge, and the summary slaughter of all animals affected or supposed to be afflicted with rabies, are indispensable precautions. It would be a matter of great difficulty to stamp out anthrax, owing to the fact that it may arise from badly-drained malarial land in which the bacilli of anthrax probably exist. M. Pasteur has had considerable success with his methods of protective inoculation against this scourge. With these and the new method of Dr. Klein we shall have to deal in due course.

In the fifteenth annual report of the Local Government Board there is much valuable material for consideration. Dr. Buchanan sums up the results of present scientific research, with the most important observation that among agencies antagonistic to the bacteria of disease possibly none will be found to equal in potency the agency of other bacteria; that probably the "self-purifying" power of our rivers, for example, is the power of some stronger septic bacterium to destroy the weaker and more mischievous bacteria which are discharged by sewers into our rivers. We recognise among bacteria differences of form, mode

of growth, manner of reproduction, degree of dependence upon air and heat, and of behaviour to certain chemical substances. Exact knowledge of the life-history and of the conditions which affect all bacteria—that is, not only those which produce disease, but also those which do not—is therefore requisite, and of an importance which cannot be over-estimated, so immense is it.

With regard to the measures to be taken with a view to the suppression of diseases, the general statement may be made that mild animal plagues may be dealt with by means of isolation, therapeutic measures, coupled with thorough disinfection; whereas, on the other hand, the virulent diseases of animals can be suppressed most easily and successfully by immediate slaughter of all animals affected or exposed to infection, or, if it should be found impracticable to kill the suspected animals, as, indeed, may often be the case, by perfect isolation of all animals which have been exposed to infection until the longest period of incubation has passed by. During the outbreak the animals certainly ought not to be removed, and all necessary regulations should be made in regard to fairs and markets.

The obvious objection to this recommendation being adopted throughout the country is that it would be an expensive matter at first. Those who support it, however, are of opinion that the first expense in such cases is the best; and, moreover, some of us feel that, so far from flinching from this bold course, we ought to feel glad that we are enabled on any terms whatsoever to fight the arch-enemy, as these virulent diseases may well be typified, with sanguine hopes of success.

There are, of course, other aspects of this question, and it must in fairness be allowed that it would be a rather serious matter to decide without a great deal of advice and consultation. One point is very clear, and that is that as things are now managed there is serious loss at times. For instance, it may be mentioned that in the week preceding Christmas 1887, this scourge, pleuro-pneumonia, broke out in one of the best-known dairy herds in Dorsetshire. The consequence was that the whole herd had to be destroyed, and the total loss resulting was estimated at about £3,000. Now it is for the purpose of avoiding the continual losses which are apt to arise that agriculturists are striving to induce the Privy Council to exercise the powers vested

in them by the Legislature, and it seems very possible that the step above spoken of may be carried out before long.

Swine fever existed in England to a large degree at the close of 1887, and even in October, 1888, this disease is still raging. We give here the return of cattle diseases as stated in the *London Gazette* of Friday for the week ending December 24th, 1887, showing that the undermentioned contagious diseases of animals at that time existed to the following extent:—

Disease.	Number of Animals.		
	Attacked.	Killed.	Died.
Pleuro-pneumonia ...	36	34	1
Anthrax	34	0	10
Swine-fever	948	250	213
Glanders	13	12	0
Farcy	14	13	0
Rabies	2	2	0

In the case of swine fever the small number of animals slaughtered by the local authorities is most observable, there being no fewer than 425 pigs attacked that had not died or been slaughtered, while 60 were said to have recovered. In Essex 140 pigs affected with the disease were allowed to live, and in Suffolk 66. These two counties, then, supplied nearly one-half of the diseased animals which were not slaughtered.

Sheep-scab, to the consideration of which we shall come in due course, also still existed in England at the above date.

As the above table shows us, rabies was not at the date referred to entirely stamped out in England, in spite of the very energetic measures which have fortunately well-nigh succeeded in staying its terrible ravages. Probably no one who has ever witnessed this disease in human beings, or indeed in dogs or any other animals, will hesitate for a single instant to conclude that the Legislature, Her Majesty's Most Honourable Privy Council, and all those who have aided in carrying out these various enactments are greatly to be congratulated on account of the success which has attended their efforts, and the good results which have accrued to England in consequence of the measures which have been carried out at different times.

In conclusion, we may lay some emphasis on another point,

namely, that the exercise of great care and judgment, coupled with common sense, would suffice to save very many out of the hundreds of cattle annually lost, owing to the want of the right kind of assistance. There is no doubt whatever that very many animals are yearly sacrificed in consequence of the lack of skilful help, or it may be, perhaps, to the want of sufficient faith on the part of the owner of stock in the resources of the veterinary art. Yet this is not to be wondered at. Indeed, even human beings often perish for want of good medical attention. Things have been so bad with many farmers that they have had plenty of work to pay their way. We may, however, look with the best of hopes to a speedy alteration in the agricultural world, and perhaps the favourable change is very near at hand. The wheel of Dame Fortune is continually revolving, bringing unexpected prizes here, and unforeseen losses there. Many farmers and others connected with agriculture, whether directly or indirectly, have had great and continued reverses; but the old halcyon days will soon come back again to them, and will find many—for farmers are a hardy and vigorous race—none the worse for the spell of bad luck, for those who have known distress best know how to steer their course to favouring breezes.

CHAPTER I.

NATURAL HISTORY AND GENERAL ACCOUNT OF THE OX.

Of all those sources of wealth open to the agriculturist, and more particularly to the British farmer, perhaps the most important and the most reliable is the breeding and fattening of cattle for the meat-market. It is undeniable that these animals are very closely connected with the comforts—nay, even almost with the very continuance, of human life. Indeed, it is a fact which cannot well be too strongly insisted upon, that the animals of the farm must now-a-days be looked upon as the chief means whereby the pursuit of agriculture may be rendered a profitable and remunerative avocation in these islands. As years roll on, it becomes more and still more obvious that Great Britain and Ireland must be converted, so far as may be possible, into pastoral countries. Wherever it may be found practicable to transform arable soil into grazing land, no time should be lost in effecting the change. So long as freights are as low as they are at the present time, when it is even the case that large quantities of grain are actually brought over as ballast, it seems well-nigh impossible that the growing of grain can be a profitable course of action for the British farmer. Indeed, we may suspect that corn will tend to remain as cheap as at present, or that it may even become cheaper; for in many parts of the world new corn-lands are being cultivated. By way of example we may point out that India has developed this industry in a large degree within recent years, and that it is now rapidly becoming a great corn-growing country. From the foregoing considerations it will be concluded that it is a point of great importance that British farmers should clearly recognize the fact that the breeding and rearing of horses, and the breeding and fattening of cattle and sheep,

are to be regarded as offering them the chief hope of gain; and that this is true, notwithstanding that immense cargoes of frozen mutton are in these days landed in a good state of preservation from the other side of the globe, and that quarters of beef are imported weekly, as also are live cattle. We need not, however, despair, for there is no country in the world which possesses such rich pasture-land, such a suitable climate and such valuable breeds of cattle and sheep as we are provided with in these islands. Hence we feel no surprise to find that, corn being very cheap, and meat still keeping up its relatively high prices, the breeding and feeding of cattle has become, and is becoming, more and more general. About fifty years ago many oxen were not sent to the butcher before they were upwards of four and a half years old. In those days the demand for meat in the north was so small that most of the cattle were sent when lean to the south, in order that they might be fattened on the pastures and the turnip-fields of the eastern counties of England. Now, however, the Scotch have no longer any need to send their cattle southwards, as they used to do in former times. Nay, even the very reverse of this is now the case, for numbers of lean cattle are sent from England and Ireland to Scotland to be fed in that country during the winter. In the month of June, 1884, the aggregate number of the horses, cattle, sheep and swine in England, Wales, Scotland, Ireland, Isle of Man, and the Channel Islands was 45,610,269; of these—

1,904,515	were horses,
10,422,762	were cattle,
29,376,787	were sheep,
3,906,205	were swine,
45,610,269	

We see, then, that the cattle of the British Islands are more valuable than are the horses; for, while we have only about 1,900,000 horses, we stand possessed of more than 10,000,000 cattle, which, moreover, in point of excellence are in all probability the best in the whole world.

Every year about 1,600,000 oxen or more are disposed of by the butcher. We may roughly compute that the average value of an ox is about £10 per head, and thus we have an aggregate

sum of £100,000,000 sterling representing the total value of the cattle of these islands. Mr. Youatt estimated the annual loss to the country resulting from disease among cattle and sheep to be about £10,000,000 sterling; but this sum is probably considerably less than the actual amount. To this we have to add that disease is a still greater source of loss in our colonies, and hence there will be no difficulty in coming to the conclusion that the chief subject we are concerned with in the pages which follow is one of the very highest moment. A most transcendently important aspect of the diseases of animals is furnished by the consideration that not only are many of these maladies both preventible and curable, but also that some, at least, of them, if not arrested, are indubitably capable of being transmitted to human beings themselves.

One of the points which comes up before us is the decision of the place which the ox occupies in the scale of animate existence. Upon inquiry, then, we learn that this animal possesses a vertebral column, and is therefore classed among the vertebrata; that it belongs to the large and important class of the vertebrata known under the name of the mammalia, animals so called on account of the fact that the females possess mammary glands, or mammæ, wherewith they suckle their young. Now this class, the mammalia, is sub-divided into three groups, respectively designated the Monodelphia, the Didelphia, and the Ornithodelphia. It is to the first of these, namely to the Monodelphia, that the ox belongs, and, in passing, we may mention that this group, which is sometimes also called the Placentalia, comprises the greater number of the mammalia. The young of the animals which compose this group are, while still within the uterus, nourished by means of an organ, the allantois, a villous and vascular development which grows out from the fœtus. The vessels of this organ come into close relationship with the blood-vessels of the uterus, thus forming the placenta, and it is by this method that an interchange takes place between the blood of the mother and that of the fœtus. This results in an absorption of nutritive materials by the fœtus and at the same time in the removal of some noxious products from the blood of the fœtus. In fact, the allantois comes into contiguity with corresponding vascular developments projecting from the inner wall of the uterus, and the interchange spoken of thus takes place

betwixt the circulating fluids of the mother and those of the fœtus. This organ, the placenta, varies widely in shape and structure in the various minor divisions of the sub-class Monodelphia, which, we may mention, includes the following ten orders, namely: Primates (man and monkeys); Chiroptera (bats); Insectivora (hedgehogs, shrews, moles, &c.); Carnivora (cats, dogs, bears, seals, walruses, sea-lions); Cetacea (whales, cachalots, narwhals, dolphins, porpoises); Sirenia (manatee and dugong); Ungulata; Hyracoidea (hyrax); Proboscidea (elephant); Rodentia (hares, rats, guinea-pigs, porcupines, beavers, squirrels, &c). Another group may be placed apart from the rest. This is the order Edentata, which includes the sloths, the armadillos, the ant-eaters of America, the pangolins and orycteropus.

Of the mammals, those which may be said to be domesticated are the horse, ass, ox, sheep, goat, camel, llama, pig, elephant, dog, cat, and rabbit. Of the above the first eight belong to the order of the Ungulata, or animals provided with hoofs. The camel, llama, and elephant cannot be said, in any strict sense of the term, to be domesticated in Europe. The ox, of course, comes under this order of hoofed quadrupeds.

In the Ungulata the whole surface of the allantois is covered with villi, and the placenta is thus diffuse. Of the earliest known representatives of these animals some resembled the Rodents, while others tended rather to approach the characters presented by the Insectivora. With the exception of the musk-deer, hoofed animals are as a rule of large size. Moreover, they are all terrestrial animals, and all are herbivorous; but some, *e.g.* the pig, are omnivorous. With regard to dentition, we may say that there is nearly always an interval or diastema in ungulate animals between the incisor and the molar teeth. Usually all three kinds of teeth are present; but the canines frequently disappear. As our readers well know, the horse possesses canine teeth, though the mare does not. Large molar teeth are always present.

Ruminants have their teeth arranged as follows:—

$$\left.\begin{matrix}\text{Upper jaw}\\ \text{Lower jaw}\end{matrix}\right\}\ \text{incisors}\ \frac{0}{3}\ \text{canines}\ \frac{0}{1}\ \text{molars from}\ \frac{5}{5}\ \text{to}\ \frac{7}{7}$$

The canine is developed especially in males, and it is often pushed up into close proximity with the incisors. The Bovidæ,

and in fact all Ruminants, in course of time have their molars ground down so as to become lunate-shaped.

With regard to the omnivorous and non-ruminating animals, as we have shown above, the pig is included among them. The teeth of this animal are suited to the mastication of many kinds of food. The canine teeth are very prominent, and in the male they project considerably and are so large that they have received the name of "tusks," which in the wilder varieties are formidable weapons. The stomach of a pig is not nearly so complex as that of the ruminant, and but slightly more so than that of the horse. The pig is possessed of four digits, two long ones and two short ones on each of the four legs. The nose or snout is prominent and cylindrical in form.

The hoofed animals may have either an even number or an odd number of toes. Those which have an odd number are called the Perissodactyla, and they include the horse and ass, the tapir, and the rhinoceros. The two genera Equus and Asinus are collectively designated the Equidæ or Solidungula, and the most prominent feature which distinguishes them is the possession of one perfect digit or finger to each leg.

The genus Equus contains only one clearly-defined species, the differences in the breeds of horses being in all probability results of the prolonged influence of different external circumstances, such as locality, management, climate, and so forth. The stomach of the horse is simple and rather small.

The Artiodactyla are sub-divided into four sections:—

(1) The non-ruminating Artiodactyla, or Swine, including the pigs, peccaries, and the hippopotamus.
(2) The cushion-footed or Tylopoda, including the camels and llamas.
(3) The Tragulina or Chevrotains. These are diminutive deer-like animals, and they were formerly thought to be like the musk-deer.
(4) The Pecora, or true ruminants, comprising the deer, giraffes, antelopes, sheep, goats, and oxen.

These Artiodactyle Ungulata, as their name implies, are provided with an even number of toes, while the other group of Ungulates called the Perissodactyles, have either one toe only or three. Now, we must here point out, however, that although

this point at first sight seems to afford a very good basis of classification, it does not on further inquiry turn out to be one of thorough and entire reliability. The extinct animal called Acerotherium, in other points approaching the Perissodactyles, was nevertheless provided with four toes on its fore limbs, as indeed the tapir of the present day is. Again, the Anoplotherium was like an Artiodactyle Ungulate, but it had three toes only on its fore legs, albeit that the hind limbs had only two toes each. Hence, as regards merely the actual number of the toes, a gradation can be traced betwixt the Artiodactyles on the one hand, and the Perissodactyles on the other. However, if we take as our basis of classification the number of toes on which the animal stands, in other words the number of those which are actually used in supporting the animal's weight, we have a far more strictly correct standard of comparison.

All the Ungulata walk and run. They do not climb, and they possess no clavicle or collar-bone. They never have more than four digits, and they walk on the ends of the digits. The metacarpal and metatarsal bones tend to assume a vertical direction. These animals are adapted for swift progression.

Ruminants masticate their food a second time, and they are all cloven-footed, *i.e.* they have two proper digits on each foot. Very generally the skull of a ruminant is provided with two horns, one on each side; and the ox, sheep, goat, and antelope are classed as Cavicornia, because their horns are hollow and supported on bony cores. As a rule ruminants are not provided with front teeth in the upper jaw, and the stomach in these animals is very large and complex.

Now in the Cavicornia, or hollow-horned group, including the sheep and goat (which are very similar to each other), also the antelopes and the Bovidæ, the skin covering the cores afterwards becomes horn. The placentation is cotyledonous.* Horns are generally present in the males. Camels, tragulidæ, and moschidæ have no horns. There are two kinds of antelopes in America, namely the prong-buck and the mountain-goat. The prong-buck throws off its hollow horns like the Cervidæ do. The chamois is an antelope met with in Europe, and there are also some in North America. Antelopes are chiefly found in Africa. Neither

* That is, the placenta consists of separate rounded masses called cotyledons.

the antelope nor the horse is found in South America, although traces of these animals have been discovered in caves of Brazil. Sheep and goats comprise a later group in geological history. The horns of these animals are well developed. Horns are generally present in the case of wild sheep, although as a rule they are not found in those which are domesticated.

The antelope has hollow horns over the frontal bone cores. With regard to the material of horns, the rhinoceros has horn only, the deer has bone only, the ox has horn and bone, and finally the giraffe has bone and skin.

The goat has a vacuity between the lachrymal and nasal bones, but the sheep has not this vacuity. The sheep is a pale-arctic animal, and only met with for the chief part in the temperate regions of the Old World. The true sheep has no beard. As for the forehead, it varies in shape. The ibex of the Alps, Pyrenees, &c. is a wild goat. Fossil forms of the goat are met with in the drift of Europe, and also in the Post-Pliocene of America. In the Miocene strata antelopes alone represent the Cavicorne ruminants.

Bovidæ. — The domesticated ox has a hairless part in the front of the mouth. There are no oxen found in Australia nor in South America. With reference to their distribution in time, it may be said that they occur in the Pliocene of Europe, but that no oxen are met with in the Miocene of Europe, although in the Miocene in India remains of Bovidæ have been found. The Bovidæ are descended from Bos primigenius, of which the nearest living representative is the Chillingham ox.

The place of the domestic ox in the scale of life is seen to be as follows, namely, that animal is said to belong to the sub-genus Bos taurus, the domestic ox; of the genus Bos, in which the horns occupy the crest, and project at first sideways and are hollow or cellular within; of the tribe Bovidæ; of the Pecora or true ruminants (animals which chew their food a second time); of the Artiodactyla or even-toed Ungulata; of the Monodelphous Mammalia, and of the Vertebrata, or animals with back-bones.

(1) There are two types of Bovidæ. One of these is the *musk ox.* The horns come close down to the nose. This ox has a long fleece and it is called Ovibos Mos-

chalus. The hair is in fact very long. The tail is very short. The animal is met with in the North American region, and it is found in the fossil form in the caves of France, together with implements.

(2) The *Yaks*.—These animals have much hair and a large tail, and they are present on the Himalayas, and are domesticated in Thibet and Angola.

(3) *Buffaloes*.—The buffaloes are really Indian forms. In Northern Africa the buffalo is used as a beast of burden.

(4) *Bison*.—The bison is an American form ; but there are a few in Europe. The fore limbs in these animals are very long.

The ox has six incisor teeth in the lower jaw, none in the upper jaw, and no tusks in either upper or lower jaw. It has six molars or large grinding teeth on each side of both jaws, and the total number of the teeth possessed is thus seen to be thirty. The forehead in our domesticated cattle is flat, and its length is greater than its breadth. The horns are smooth, round, and tapering, and they rise from the extremities of the frontal ridge. Some breeds of oxen are not provided with horns, and these appendages differ very greatly in point of length and curvature in the several varieties. These animals are probably natives of Asia and Europe, and perhaps also of Africa, and it is quite possible that they may have been domesticated at different times and in different countries. It cannot be said that the ox is met with in a truly wild state, although oxen which are designated wild are found in great numbers on the pampas or wild grassy plains of South America; but it is certain that they are not indigenous in that country. Moreover, the wild cattle which still exist in one or two parks in Britain are in all probability direct descendants of domesticated oxen. In reference to the remoter origin of the ox, it does not appear to be decided whether or not the Urus, described by ancient writers as an inhabitant of Central Europe, was the progenitor of our domestic ox.

The ox was probably used as a beast of burden or of draught before the cow was valued on account of its supply of that nutritious article of diet, milk. In some parts of Europe this animal is more often employed in that capacity than is usual

amongst us. The gait of the ox is slow and laborious, but the strength of the animal enables it to perform a considerable amount of slow and steady work without exhaustion, provided that the animal is treated with due care. It requires intervals of rest, partly for chewing the cud, and it is by no means able to put itself to strenuous exertion as the horse can. The ox is especially valuable by reason of its flesh and its milk; but almost every part of the animal is of use—the skin, the horns, the fat, and even the hair, and the intestines.

We now give in brief the general characters of the frame and build of the ox. In the first place it is to be noted that perhaps the most important point is that there should be a sufficient capacity of chest, in order that both heart and lungs may perform their due functions properly. The thoracic cavity, therefore, should be both wide and deep, and over the whole length of the ribs both length and roundness should be observable. The barrel must be both hooped and deep. The space intervening betwixt the ribs and the hips should be but small. As for the cow, the belly may be somewhat large and drooping without disparagement, and should her milk-veins be large and swollen so much the better, for this will imply capacity for giving milk. It is most desirable that the roundness and depth of the belly should be marked behind the point of the elbow rather than between the shoulders and fore-legs, and also that the belly should extend low down rather than upwards towards the withers. The loins should be wide, for they are the prime parts, and they should also rather seem to extend far along the back, and although the belly should not hang down in a pendulous manner, the flanks should be round and deep. The hips should not be ragged; but they ought to be large and round rather than wide, and have plenty of muscle and fat on them. The thighs, too, should be full and also long, and, when looked at from behind, in close proximity; and to this it may be added, that the further down they continue to be near together the better may they be considered to be. The legs should be short, since with the possession of short legs power of fattening is supposed to be allied. The bones of the legs should be small, but not, of course, so unduly small as to indicate weakness of constitution, and liability to the ravages of disease. In like manner, the hide should be thin, but not, of course, unduly

thin; movable, but not too loose, mellow, and, moreover, well covered with soft, fine, and glossy hair.

At about two and a half years of age, the ox has reached its full development; it is aged when ten years old, and very rarely is its life prolonged for more than fourteen years. For ages past the cow has been considered as a valuable possession, on account of the milk which she yields. The period of gestation is 270 days, or nine months, and but seldom is it the case that more than one calf is produced at a birth. After cows have reached the age of about seven and a half years they are very rarely used for dairy purposes, since they then yield a less quantity of milk, and even that is of an inferior description.

Not only are cows a source of profit by reason of their power of giving milk—from which, of course, butter and cheese are made—but also in so far as they can give origin to offspring well adapted for grazing, and capable of being readily fattened for the meat-market. As a rule, the calf is carefully tended and fed from the time of its birth until the time of disposal to the butcher, and oil-cake is now generally considered to be the best auxiliary food for both old and young stock. In the pastoral districts of England, the rearing of the cattle to be afterwards sent to the arable districts is carried out. A great many oxen are fattened on turnips and mangolds in the winter-time in Norfolk and other eastern counties, plentiful allowances of corn and cake being supplied in addition to the roots. Now-a-days it is the custom to fatten cattle for the market at an earlier age than was formerly the case.

The ox is, as our readers well know, a sociable or gregarious animal, and where it is practicable so to do—as, for instance, in the South American plains—the cattle associate together in such numbers as to form very large herds. These herds defend themselves with great vigour against the large feline animals and other assailants, whenever they are attacked. In order to meet their fierce adversaries effectively, these creatures draw themselves up in battle array, placing all the younger and the weaker in the centre, whilst the bulls in the outer ranks confront the enemy, with their formidable horns presented all ready for the furious onset.

In seeking what is known about the history of the ox, we find that that animal has been present in almost every place

where man himself has lived. In the 19th and 20th verses of the 4th chapter of the Book of Genesis we read :—" And Lamech took unto him two wives: the name of the one was Adah, and the name of the other Zillah. And Adah bare Jabal: he was the father of such as dwelt in tents, and of such as have cattle." Further, in the 16th verse of the 12th chapter, we find written: —" And he entreated Abram well for her sake. And he had sheep, and oxen, and he-asses, and men-servants, and maid-servants, and she-asses, and camels." This happened in relation to Sarai, Abram's wife, whom he endeavoured to pass off as his sister, a deception which was found out after the Lord caused plagues in Pharoah's house. This occurrence took place about 130 years before any mention is made concerning the horse.

For some of the observations which now immediately follow, we are indebted to the valuable work entitled *Bible Animals*, written by the Rev. J. G. Wood, that well-known and deservedly popular author. From him we learn that there are two distinct kinds of cattle found in Palestine—namely, the ordinary domesticated ox, and the Indian buffalo, which lives in the low-lying and marshy valley of the Jordan. As for the domesticated cattle they are very much like our own, although, of course, as is only to be expected, we do not meet with that diversity of breed with which we are familiar in the British Islands, nor is there even that distinction betwixt long-horned and short-horned oxen, which in this country is so well known. As is the case in most parts of the world where civilization has made any progress, so also in Palestine, domesticated cattle were, and still are, numerous, although it is very evident that, in the prosperous days of Judæa, there were far greater numbers of them than there are now, and, moreover, that they were treated in a much better way.

A constant supply of them was needed for the sacrifices, certain cattle being appointed to be slain for this purpose. The ox was in those days largely fed and fattened for the table, while at the present time the flesh of cattle is scarcely used at all for food, that of the sheep or goat being always used, even when a man gives a feast to his friends.

Calves, and especially bull-calves, were much used for food in Palestine, and in the households of the wealthy they were fattened for the table. Still, even in the times of Israel's prosperity, the

chief use of the ox was in agricultural labour. Ploughing was and is always performed by oxen, and allusions to this fact are plentifully scattered through the Old and New Testaments.

Each "yoke" comprised two oxen. The yoke itself, the chief part of the harness, is of very simple construction. A tolerably stout beam of wood is cut of a sufficient length to rest upon the necks of the oxen standing side by side, and a couple of hollows are scooped out to receive the crests of the two necks. In order to hold this in its place, two flexible sticks are bent under their necks, and the ends fixed into the beam of the yoke. In the middle of this yoke the pole of the plough or cart is fastened, and this comprises all the harness used, even "traces" not being requisite. The yoke is very frequently mentioned in Holy Scripture, as in the verse, "Take my yoke upon you; for my yoke is easy and my burden light." The instrument used for driving the cattle was a goad, a long and stout stick, armed at one end with a spike, and having a kind of spud at the other, by means of which the earth could be scraped off the share when it became clogged.

After the land had been ploughed, the seed sown, and the harvest had ripened, the labours of the oxen were again called into requisition, firstly for threshing out the corn, and secondly for taking the grain to the storehouses. The process of threshing was a very simple one in the early times. A circular piece of ground, the average diameter of which would be about 75 feet, was levelled and beaten so as to be very hard and flat, and then on this ground the corn was thrown, and a number of oxen were driven about on it, so that the constant trampling of their feet shook the ripe grain out of the ears. The corn was gathered together in the middle of the floor, and as fast as it was scattered by the feet of the oxen, it was thrown back again towards the centre. Afterwards a rough sledge or "moreg" was introduced. To this the oxen were harnessed by a yoke, on which the driver stood as he guided his team round the threshing-floor. The work of treading out the corn was a hard and trying one to the oxen, and it was probably for this reason that the kindly edict was made, that the oxen who trod out the corn should not be muzzled. Our readers will, perhaps, remember the verse, "Thou shalt not muzzle the ox when he treadeth out the corn" (Deut. xxv. 4).

In the general way, the cattle were not nearly so carefully fed as they are with us in these days, and hence the labour of threshing would be attended with some compensatory advantage in the temporary abundance of which the animals might take their fill, provided they were not muzzled. After the corn was threshed, the oxen were used to draw it home in carts, which were simply trays or shallow boxes mounted on a pair of wheels. The wheels were merely slices cut from the trunk of a tree and were not furnished with iron tyres, and they were not very round, but were soon worn so as to be irregularly oval. The axle, too, was simply a stout pole fastened to the bottom of the cart, and having its rounded ends thrust through holes in the middle of the wheels, and consequently the friction was enormous. As, moreover, oil and grease were far too precious to be used for lubricating the axles, the creaking and groaning of the wheels was extreme. Although the cattle were evidently then tended with more care than at the present day, those animals which were used for agriculture seem to have passed rather a rough life, especially in the winter. The Jews were not acquainted with the idea of preserving the grass by making it into hay, and hence the chief food for the cattle was the straw and chaff which was left on the threshing-floor after the grain had been separated. Many parts of Palestine are entirely devoid of cattle, and only those districts in which fresh forage may be found throughout the year contain them. Except a few yoke of oxen which are kept in order to draw carts and act as beasts of burden, the cattle are turned loose for a considerable part of the year, and they run about in herds from one pasturage to another, and therefore regain many of the characteristics of wild animals. Hence have arisen many of the Scriptural allusions such as: "Many bulls have compassed me, strong bulls of Bashan have beset me round. They gaped on me with their mouths (or, their mouths opened against me) as a ravening and a roaring lion."

"When I was a boy," writes the Rev. J. G. Wood, the author to whom we are indebted for some of the foregoing information, "I sometimes amused myself with going into a field where a number of cows and oxen were grazing, and lying down in the middle of it. The cattle would soon become uneasy, toss their heads about, and gradually draw near on every side, until at last they would be pressed together closely in a circle, with their heads just above the object of their astonishment. Their curious, earnest looks have always been present to my mind when reading the above-quoted passage."

The bulls of Palestine are gentle in comparison with our own animals, and in fact in that country a pair of bulls may constantly be observed attached to the same yoke, a thing that never would be seen in this country. The cattle are branded with the mark of their owners, so that there might be no difficulty in knowing them when they are recaptured for the plough and the cart. In the olden times of the Israelitish race, herd-keeping was looked upon as an honourable occupation, in which men of the highest rank might engage without any derogation from their dignity. Even Saul himself, after he had been appointed king, was acting as herdsman when the people saw the mistake they had made in rejecting him as their monarch, and came to fetch their divinely appointed leader from his retirement.

That the ox was tamed at a very early date is shown by the writings of Moses, and also by the worship of the animal in Egypt, which worship was imitated by the Israelites when they made their golden calf at Mount Sinai and at subsequent times. It is indeed well known that the ancient Egyptians worshipped the ox, and similarly it is the case that the same animal was held in veneration by the Indians, whose legends record that the ox was the first animal created by the three kinds of gods who were commanded by the Supreme Being to people the earth with living things. Again, according to the traditions of every Celtic nation, the cow was one of the earliest productions, and in some measure was even supposed to be a fit representative of some divine principle. As we have above implied, the Israelites learned to worship cattle during their long residence in Egypt.

Chief among the idols or symbols was the god Apis represented by a bull. Many other animals, especially the cat and the ibis, were deeply honoured among the ancient Egyptians, as indeed we learn both from their own monuments and from the works of the old historians. All these creatures were, it seems, symbols in the eyes of the educated, but idols in those of the ignorant. The bull, Apis, was held in highest honour. The particular animal which represented the deity was lodged with great state and honour in his temple at Memphis. It was thought to be divinely selected for the purpose. The colour of this animal was black, with the exception of a square spot on the forehead, a crescent-shaped white spot on the right side, and the figure of an

eagle on the back. It was thought necessary that there should also be under the tongue a knob, shaped like the sacred scarabæus, and that the hairs of the tail should be double. The animal, which thus represented the deity was only allowed to live for a certain time, and when he had reached this allotted period, he was taken in solemn procession to the Nile, and drowned in the sacred waters of this river. The body was then embalmed, and placed with ostentation in the tombs at Memphis. After his death, whether natural or brought about in any way, the whole nation went into mourning, exhibiting all the conventional signs of sorrow, until such time as the priests found another bull which possessed, or was thought to possess, the distinctive marks. The people then went out of mourning and donned their best attire, and the sacred bull was exhibited in state for forty days before he was taken to his temple at Memphis. Similarly, some of the Indian cattle are thought to be little less than incarnations of divinity. In spite of the terrible and swift punishment which supervened upon the worship of the calf in Aaron's time, the idea of ox-worship still remained among the people. Five hundred years afterwards we find a familiar example of it in the conduct of Jeroboam, "who made Israel to sin," the sin being the open revival of ox-worship. The king made two calves of gold, and said: "Behold thy gods, O Israel, which brought thee out of the land of Egypt." Here we have a singular instance of a king of Israel repeating, after a lapse of five hundred years, the very acts which had drawn down on the people so severe a punishment, and which were so contrary to the law that they had incited Moses to fling down and break the sacred tables on which the commandments had been divinely inscribed. Other monarchs followed his example, and departed not from the ways of Jeroboam the son of Nebat, who made Israel to sin.

Another species of the ox tribe now inhabits Palestine, though commentators rather doubt whether it is not a comparatively late importation. This is the true buffalo (*Bubalus buffelus*, Gray), which is spread over a very large portion of the earth, and is very plentiful in India. In that country there are two distinct breeds of the buffalo, viz. the Arnee, a wild variety, and the Bhainsa, a tamed variety. The former of these is much larger than the latter, being sometimes more than 10 feet in length from the nose to the root of the tail, and measuring between

6 and 7 feet in height at the shoulder. The horns are of enormous length, the tail is very short, and tufts of hair grow on the forehead and horns. The tamed variety is at least one-third smaller, and, unlike the Arnee, never seems to become well-conditioned. It is an ungainly kind of animal, and very unsightly on account of the bald patches mostly found upon its hide. The buffalo loves the water, and always inhabits the low-lying districts. It is fond of wallowing in the marshes, in which it lies for hours, almost entirely submerged, and tranquilly chewing the cud while enjoying its mud-bath. Little more than the animal's eyes, ears, and nose remain above the surface, so that the motionless heads are scarcely distinguishable from the grass and reed tufts which stud the marshes. One may pass by a silent and tranquil pool where the muddy surface is unbroken except by a number of black lumps and tufts of rushes, and then these tufts may suddenly be transformed into twenty or thirty huge beasts rising out of the water as if by magic. If so, it is best to get out of the way as quickly as possible, as the buffalo is apt to resent being startled out of its state of dreamy repose.

In the Jordan valley the buffalo is found, and is used for agricultural purposes, being of the Bhainsa, or domesticated, variety. It is larger and stronger than the ordinary cattle, and hence the animal is useful in drawing the plough ; but its temper is uncertain. As is the case with all half-wild cattle, its milk is very scanty, but is of a very rich quality.

The Urus, an animal which possibly was the distant progenitor of the modern ox, was fierce and of enormous size. Now, it is to be remembered that in almost every part of the Continent and of England the skulls of oxen far exceeding in size any now known have been found. A fine specimen is preserved in the British Museum. The horns of this skull are of a peculiar description. They resemble some smaller ones dug up in the mines of Cornwall, and in some measure those of the wild cattle of Chillingham Park, and also, although, as is only natural, in a much less marked manner, those of our native breeds of cattle now found in Devon and East Sussex, and those of the Welsh mountains and the Scottish Highlands. It seems impossible to trace the migrations of the ox, which must have gradually taken place from its ancient home in Western Asia towards the West; but we cannot doubt that the characters of the animal were

gradually changed in correspondence with the very different climatic and other conditions, as of pasture, environment, and so forth, to which that animal must at various times have been subjected.

When the ox is domesticated, unless he is taught to draw the cart or the plough, he is apt to lose in point of instinct. In this respect the ox of Lancashire and that found in Devonshire offer a very striking contrast; for while the former has very little sense, the latter approaches even the horse in activity and in docility, is easily broken in to his work, and displays gratitude towards his feeder. In illustration of the sagacity possessed by cattle, we now turn for a few moments to the first volume of *Burchell's Travels into the Interior of Africa.* On page 128 this author informs us that the native oxen are usually broken in, for the purpose of riding, when not more than one year old. The animal having been thrown upon its back, a slit sufficiently large to admit a finger is made through the cartilage or septum, which separates one nostril from the other. A strong stick, provided with a little forked branch at one end, so that it cannot slip through on that side, is then procured, and the bark having been stripped off, it is pushed through the hole in the cartilaginous septum. A thong of hide of sufficient length to reach round the neck and form the reins is then fastened to each end of this stick. Across the back is then placed a sheep's skin on which the wool has been left, another one being folded up and placed across the back, and kept in position by means of a rein long enough to pass several times round the body. This contrivance forms the saddle, and to it stirrups are sometimes added by the simple device of slinging across it a thong provided at each of its ends with a loop, which may be stretched by means of a piece of wood placed so as to form a rest for the foot. While the nose is still sore, the animal is mounted and trained, and in about a week and a half is usually made fairly obedient to the rider. The Hottentots manage the ox with facility and skill, making the animal walk, trot, or gallop, according to their wish. Their walking pace is about three or four miles an hour, their trotting pace about five miles an hour, and they gallop even as much as about seven and a half miles an hour.

We also find that Major Denham, in his *Travels into Central Africa*, states (on page 321) that the beasts of burden employed

by the inhabitants are the bullock and the ass, and that a very fine breed of asses are found in the Mandara valleys. It appears also that strangers and chiefs in the service of the sheikh or sultan alone possess camels. Bullocks are laden with all the grain and other articles taken to and from the markets. A small saddle of plaited rushes is laid on the animal, and then sacks of goat-skins full of corn are lashed on his broad back. A leathern thong passed through the cartilage of his nose serves the purpose of a bridle, and the owner or his wife or slave is seated on the top of the load. Sometimes the daughter or the wife of a rich shouaa, mounted on her particular bullock, precedes the loaded animals, extravagantly and luxuriously adorned with amber, silver rings, coral and all sorts of finery, her hair streaming with fat, a black rim of kohal, at least an inch wide, round each of her eyes, and indeed arrayed for conquest at the crowded market. Carpet or robes being then spread upon her clumsy palfrey, she sits, *jambe de çà, jambe de là*, and with much grace guides the animal by the nose, and sometimes even makes him caper and curvet.

Likewise, in illustration of the sagacity of oxen, we may here point out that Captain Cochrane, in his *Travels in Colombia* (vol. ii., page 251), tells us that he was on one occasion suddenly aroused by a most terrific noise of loud roarings and deep moans, which at the late hour had a very weird and appalling effect. He went out at once, attended by the Indians, and found close to the rancha a large herd of bullocks from the surrounding country collected together around the spot where a bullock had been killed in the morning. They roared, moaned, tore up the ground with their feet, and bellowed forth, perhaps, the most hideous chorus of grief which mortal ears could hear. It was only with the greatest difficulty that they were driven away by men aided by dogs. This same traveller also informs us that he has witnessed a similar scene in the day-time, and that he observed large tears rolling down the poor animals' cheeks.

Again, in *The Illustrations of Natural History* (page 72), we read that in "the Swiss Canton of Appensell, pasturage being the chief employment of the inhabitants, the breeding of cattle, and the subsequent management of the dairy, are carried to the greatest perfection. The mountaineer lives with his cows in a perpetual exchange of reciprocal acts of kindness; the latter affording almost all that he requires, while they in their turn are

provided for and cherished by him as if they were his children. They are never ill-treated nor beaten, for his voice suffices to guide and govern the whole herd, and a perfect cordiality reigns between them. In the Alps the fine cattle are the pride of their keepers, who adorn the best of them with a harmonious set of bells, which chime in accordance with the *Ranz des vaches*. The finest black cow is adorned with the largest bell, and the two which come next in appearance wear smaller ones. Early in the spring, when they are removed to the Alps, or to some different pasturage, the owner dresses himself in all his finery, and proceeds along singing the *Ranz des vaches*. Next come three or four fine goats, next the finest cow adorned with the great bell, then the other two with the smaller bells, and these are followed by the rest of the cattle walking one after another, and behind them comes the bull having a one-legged milking stool on his horns, while the procession is closed by a sledge bearing the dairy implements. It is indeed surprising to observe the pride and pleasure with which the cows stalk forth, when ornamented with their bells. If the leading cow is deprived of her honours, she manifests her sense of the indignity put upon her by incessant lowing, and even, it is said, by loss of appetite, whereby her condition is impaired. The rival becomes the object of her wrath. She is butted and wounded in the most furious manner, until the aggressor either regains her bell, or is removed from the herd.

Oxen are spoken of by Cæsar as constituting a chief part of the wealth of the Britons at the time of the Roman invasion, and the same writer also mentions that the inhabitants lived in great part on the flesh and the milk of these animals, somewhat to the neglect of the use of the plough. It seems that these oxen were neither large nor beautiful animals. At that time Great Britain comprised many petty sovereignties, and only that kind of property which could be quickly taken away to a place of comparative safety was really secure. Even many centuries afterwards there were continual contests among the feudal barons, and it was therefore still the case that those goods which could be secured within the walls of a castle, or driven quite away to some place out of the reach of an enemy, were alone to be considered as being of any great value. Consequently it was a customary precaution to store up in the fortresses immense stocks of provisions suited for the use both of the vassals and of the cattle, or perhaps

the latter were driven to the lands of some friendly baron, or concealed in some recess. When, however, the government became more powerful, and a settled peace and freedom from internecine struggles and internal dissensions became the order of the day, property of every description was far more secure and also more equally divided. The plough, too, then gradually came into general use; for then it was reasonably to be expected that the reaping of agricultural products might be fairly anticipated, when once they had been sown. At about this period cattle were somewhat neglected, and both the number and the size of them gradually became less. Indeed, it has been only within the last fifty years or so that serious and successful attempts have been made for the purpose of improving our breeds of cattle. As our ancestors roved about, their cattle were apt at times to stray and to be lost. The country at that time contained a great many forests, and the oxen which had strayed betook themselves to the recesses of these woods, and became wild, and at length so numerous and ferocious as to be a source of danger to the people living near. There were, at one time, a great number of these savage animals in the forests situated near the metropolis. As the country gradually became more and more highly civilised, and the forests were thinned, these creatures were almost entirely stamped out. A few of them, however, still remain in Chatelherault Park, belonging to the Duke of Hamilton, in Lanarkshire, and also in the park of Chillingham Castle, in Northumberland, the seat of the Earl of Tankerville.

These peculiar wild cattle we shall describe later on; but our consideration of them will best come in our remarks on the different breeds of cattle, which topic we shall shortly proceed to discuss.

CHAPTER II.

THE ANATOMY OF THE OX.

SECTION I.—THE SKELETON OF THE OX.

Before we introduce our kind and patient readers to a subject which at first sight seems very dry and uninteresting, we must beg for an especial degree of indulgence. As a matter of fact, many topics appear difficult which are really not so if they are approached in the right way. We are, however, far from thinking that we have done this part of our work thoroughly, or, at any rate, anything like so satisfactorily as we might have hoped to have done it, had it been possible to have expended more time upon it. However, we have delayed the appearance of our work quite as long as was advisable, and hence we must be content to leave this section in its present state, hoping that if the readers will peruse our remarks with the aid of actual specimens before them, so far as possible, they will be able to learn the main points quickly and correctly.

Speaking generally, the proportion of animal matter in fully-developed bones may be said to be about one-third. Sometimes, especially in young animals, there may be too large a proportion of animal matter, and when young animals suffer from rachitis their bones may be incapable of supporting the super-incumbent weight. Again, bones differ in regard to density. For example, the bones of the legs of a cart-horse are larger than those of a thoroughbred; but at the same time they do not weigh so much in proportion to their size, because the shell or outer layer is thinner. In the case of the thoroughbred it is clear that a greater compactness of osseous tissue is necessary in order to resist the great amount of concussion engendered by the

speedy pace. Hence the shell of the bones is thicker, and thereby, of course, greater strength is afforded without much increase in size.

The Vertebral Column.—The ox has 7 cervical vertebræ, 13 dorsal, 6 lumbar, 5 sacral, and from 16 to 20 coccygeal vertebræ. The sheep differs by having 6 or 7 lumbar, 4 sacral, and also from 16 to 24 coccygeal vertebræ.

Taking first the cervical vertebræ into consideration, we find that these vertebræ in the case of the ox differ from those of solipeds by their shortness and by the greater development of

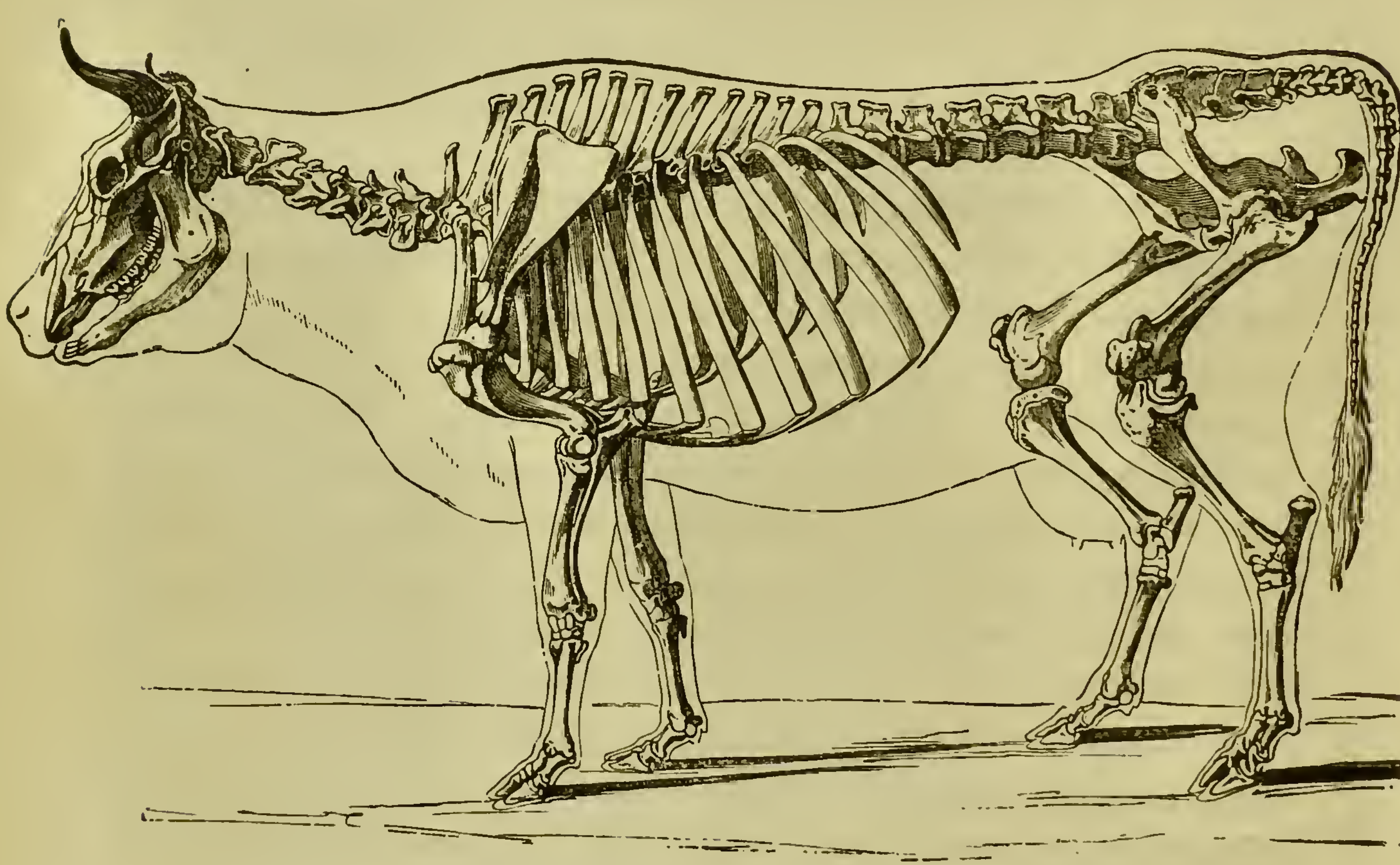


Fig. 1.—Skeleton of the Cow.

the eminences for the insertion of muscles. The bodies of the cervical vertebræ of the ox are, in fact, shorter than are those of the horse. The neural spines are large. The *atlas*, or first cervical vertebra, is very large, but it is smaller than is that of the horse. Its alæ are more horizontal, and they are turned up slightly at the external borders. The spinal foramen is large, and there is no posterior lateral one. The condyloid articulations are wide. The transverse processes of the atlas are less inclined than in the case of the horse. The posterior facets for articulation with the axis are small and nearly flat, and blended into one.

The second cervical vertebra, or *axis*, is short, the odontoid process being broad and bounded inferiorly by a prominent articular ridge. The odontoid process in ruminants is spout-shaped. The neural spine does not bifurcate, nor does it become continuous with the posterior articular processes. The pedicles on either side are perforated by a circular foramen. The body is semi-cylindrical, not conical, and it is so concave on its upper surface as to present the appearance of a groove. The spinous process of the axis is not so thick as in the case of the horse, and it is not bifid posteriorly.

In the five cervical vertebræ which come after the axis, a rugged continuous lamina unites the anterior articular processes to the posterior ones. The spinous process inclines forward, and at its summit is flat in the transverse direction, and is in some cases bifid. It becomes progressively higher from the third to the fifth cervical vertebra. The transverse processes of the sixth vertebra are long, and only provided with two prolongations, a superior and an inferior one. The latter is large, and flat on both sides, and is bent abruptly downwards. The spinous process of the sixth cervical vertebra is long, namely, about $1\frac{3}{4}$ inch in height, and it is flattened laterally. This vertebra has no inferior spine. The seventh cervical vertebra is provided with a spinous process which is the longest. It is as much as $4\frac{5}{8}$ inches in height, and points backwards and upwards. The transverse processes are single, and end in rough tuberosities. This vertebra is not provided with an inferior spine, and only seldom with a vertebral foramen.

Dorsal Vertebræ.—The centra of the dorsal vertebræ of the ox are very similar to, though longer and thicker than, those of the horse. Their spinous processes also are larger, and incline more markedly backwards. Their transverse processes are very large, and provided with a facet which is convex from above downwards, and their posterior notches are nearly always converted into foramina. These dorsal vertebræ are more slender in the middle than at the extremities. The spinous processes diminish in width, especially at their summits, from the first to the eleventh dorsal vertebra, and then again widen in the two last. They increase in slope to the tenth, after which they become more and more upright. The first four are the longest, and are nearly of the same height. The others gradually dimi-

nish. The articular facet of each transverse process of the first four or five vertebræ retains its vertical convexity, and is, moreover, concave in an antero-posterior direction. In the case of the last vertebra this facet is always absent, and sometimes also in the last but one. The two last dorsal vertebræ have the articular processes arranged similarly to those of the lumbar vertebræ.

The bodies of the dorsal vertebræ of the ox are longer than are those of the horse; but they are very similar in form. The pedicles are almost always pierced by foramina which correspond to the posterior notches. The transverse processes are large, and they diminish in size and assume an arched form from before backwards, and those of the fourth dorsal vertebra are usually the longest. The dorsal vertebræ of the sheep and goat, as is to be expected, are relatively less strong than are those of the ox. Their spinous processes are, moreover, not so wide, and their posterior notches are never converted into foramina.

The lumbar vertebræ of the ox are longer and thicker than in the horse, the bodies being more convex on the lateral and inferior surfaces. The transverse processes are, as a rule, long and more strongly developed, concave on the anterior border, convex on the posterior, and they incline slightly downwards, with the exception of the two first, which remain nearly horizontal. Moreover, they increase in length from the first to the fourth vertebra, those of the fourth being therefore the longest, though those of the fifth are not much less, and those of the last suddenly become shorter. Their width gradually diminishes from before to behind. The lumbar vertebræ do not articulate with one another, nor with the sacrum. Their articular processes are small and prominent, and further removed from the median line in the posterior vertebræ.

The Sacrum.—The sacrum of the ox is larger and more prominently arched than is that of the horse, and its superior surface is more convex. The spinous processes are more firmly united, and they are also surmounted by a thick rugged lip. They are lengthened at their base and on each side by a ridge which represents the rudiments of the articular processes. The lateral borders are sharp, and bent downwards. The superior foramina are not very markedly regular, the under surface is more concave, the promontory is more marked, and the inferior

foramina are larger. The sacral cornua are large and expanded for the attachment of ligaments. The lumen of the spinal canal is of an oval shape, and the articular portion of the body is large. The transverse processes are short and thick, and their external extremities are bounded by a vertical border, the inferior angle of which is directed downwards. The surfaces which serve to unite the sacrum with the ossa innominata have, in fact, a more or less vertical direction. There are no lateral facets on the base of the sacrum for articulation with the transverse processes of the last lumbar vertebra. In the sheep and goat the sacrum is shorter, and sometimes the spinous processes are not united. The coccygeal vertebræ of ruminants are stronger than those of the horse. They vary in number from fifteen to twenty, and the anterior of them possess rudimentary articular processes. The sacrum of rodents presents certain characters not dissimilar from that of ruminants. As a rule, only one vertebra touches the ilium on each side. No ruminant has a prehensile tail. There are no chevron bones in ruminants; but the ox has hypopophyses in the tail.

The Ribs.—As a general rule, ruminants possess thirteen pairs of ribs, of which eight are true and five false. The pig has fourteen pairs of ribs. They are straight, and broader, longer, less markedly arched, and more uniform than are the ribs of solipeds. The superior extremity is large and smooth. The necks of the foremost ribs are short and thick, and their tubercles are large. The necks of the posterior ribs are very long and thin, and also they are smaller than in the horse. The angles are not very marked, and the front extremities are expanded so as to articulate with their cartilages by means of true joints (diarthrodial articulations). In the last rib, and sometimes also in the last but one, the tuberosity is scarcely perceptible, and it has no articular facet. In the sheep and goat the sternal ribs are united with the cartilages.

The Sternum.—The sternum of the domesticated animals, except solipeds, is flat both above and below, instead of from side to side. The superior surface is concave, forms the floor of the chest; the inferior is convex, but slightly concave from side to side. On the borders between each two segments are articular depressions for the costal cartilages. The cariniform cartilage is small and conical, while the ensiform cartilage is

large and circular. In the case of the sternum of ruminants each piece is developed from two centres of ossification situated side by side. Seven separate bones make up the sternum in these animals, and they are much more closely united than are the bones which compose the sternum of the horse. With the exception of the first piece, the rest are united with one another by ossification at an early period. The first segment or manubrium, however, is joined to the second by a true diarthrodial articulation, whereby it can move laterally. There is no cervical prolongation, and the xiphoid cartilage is only slight, and it is, moreover, well detached from the body of the bone. This diarthrodial articulation between the two first pieces is not present in the case of the sheep and the goat. In these animals they are simply united by a layer of cartilage, which in old animals is completely ossified.

Pelvis.—The pelvis of a ruminant is very long, and the hind legs are longer than the fore legs. The symphysis also is long.

The os innominatum is larger, but of the same general appearance as is the same bone of the horse. The ilium is thick, and is marked with a prominent line, which runs from the anterior spine to the superior ischiatic ridge. Its internal surface is very convex, the ridge between the part resting on the sacrum and that which lies without it being well marked. The ilio-pectineal eminence is prominent, and the crest and spines are very strong. The ischium is of about the same size as the ilium. The anterior extremity has a thick projecting external portion, which forms part of the cotyloid cavity, and is surmounted by the large superior ischiatic spine, from which a slight ridge is continued backwards over the thick concave body to the tuberosity. The inferior ischiatic spine is conical in shape, and it points outwards and downwards. On the ischial symphysis inferiorly are a ridge and tubercle, which are absent in the case of the horse.

The pubis is large and concave. The symphysis pubis is never completely ossified. The cotyloid cavity is deep, and the cotyloid notch is narrow and deep, and near the large foramen ovale. The inlet of the pelvic cavity is oval, and its sacro-pubic diameter is greater than its transverse one, while the sacro-ischiatic diameter of the outlet is less than the transverse.

The Hind Limb.—The *femur*, or thigh-bone, is distinguished

from that of the horse by the absence of the lesser trochanter. The trochanter internus is a round tubercle situated near the posterior surface. In no ruminant is there a third trochanter. The head of the bone is small but prominent, the trochanteric fossa deep but small. The trochanter major has only one eminence, which is not very prominent, and is united to the internal trochanter by a ridge. The condyles and trochlea are somewhat small, and the supracondyloid fossa is shallow.

The *tibia* has no vertical fossa on the anterior tuberosity, and no articular facet for the fibula. The distal extremity has its external malleolus represented by a separate bone called the *malleolar bone*. This articulates with the tibia, calcaneum, and astragalus, and it also represents the distal end of the fibula, the remainder of which bone is usually replaced by a long ligament which stretches along the whole length of the tibia. As a rule, in ruminants the fibula is aborted, but this is not the case in tragulidæ. The patella is small, and somewhat conical in shape.

The tarsus consists of five bones. The astragalus is deep but narrow, and has a pulley-shaped surface inferiorly as well as superiorly. The calcaneum is long and square. The great cuneiform (cuneiforme magnum) and the cuboid are united to form the cubo-cuneiform bone. The cuboid and scaphoid bones are never found in ruminants. The cuneiforme medium is like that of the horse, while the cuneiforme parvum is very small. The large metatarsal bone has its inferior extremity divided into two equal parts by a deep fissure, and it has a groove superiorly. The small metatarsal bones, when present, are rudimentary and single.

THE SHOULDER AND FORE-ARM.—The scapula is large and very triangular. The spine, which as a rule in ruminants is short, divides the scapula into two fossæ, which, as regards their extent, stand to each other in the ratio of about one to three. The spine does not gradually end in the neck as that of the horse does, but in the abrupt angle prolonged to a point to which the name acromion process has been given. The neck is more distinct, and the coracoid process and glenoid cavity are both small, and situated close together.

The bicipital groove of the humerus is single, the external trochanter is very large, and its summit is curved over the

bicipital groove. The head is large, the tuberosities on the contrary being small, while the bone itself is less markedly twisted than is that of the horse.

The fore-arm is short in the ox, sheep, and pig, although that of the carnivora is very long. In the case of solipeds, ruminants, and in pachyderms, in the general way the radius and ulna are so firmly united by means of an interosseous ligament that these two bones can only execute slight movements in relation to each other. The radius and ulna are, in fact, fused; but they are separate in tragulus.

In ruminants the ulna is an elongated bone, being longer and larger than is the ulna of the horse. It extends as far as the distal end of the radius, and it articulates with the cuneiform bone. The radius, on the other hand, is short, very flat from before to behind, and the bicipital tuberosity is scarcely noticeable. There are two radio-ulnar arches, and they are united externally by a deep fissure.

In the ox and sheep the carpus is only composed of six bones in all, four in the upper row, and only two in the lower row, in which the os magnum and the trapezoides are united. The four bones of the upper row are the scaphoid and the lunar, which articulate with the radius, the cuneiform, which articulates with the radius and the ulna, and the trapezium, which is small, tuberous in shape, and does not articulate with the radius. The two bones of the lower row are the os magnum and the cuneiform, which articulate with the large metacarpal bone, the trapezoid being fused with the os magnum, or absent, according to some observers, and the pisiform bone being wanting. The supercarpal bone has no groove for gliding, and the pyramidalis articulates with the radius and cubitus. The bones of the lower row only articulate with the principal metacarpal bone. Professor Gobaux, in 1865, exhibited specimens to prove that the interval of the two bones of the lower row in the carpus of ruminants really represents two bones, so that these animals actually have seven carpal bones, like the horse has. Ruminants have two metacarpal bones, a chief one, which itself results from the consolidation of the second and third metacarpals, and another one which is quite rudimentary. In reality the cannon bone is composed of two bones united. The metacarpals are as a rule fused. The ox has the second and fifth phalanges only rudi-

mentary. The large metacarpal bone has a vertical groove down its anterior middle, and this groove marks the original division of the bone into two. The inferior extremity is divided by a deep fissure into two articulations, each resembling the single one of the horse, the external one being always the smaller. A rudimentary metacarpus is placed postero-externally. The phalanges and sesamoids in either limb are double, one set forming each digit. They are small and narrow, the coffin-bone resembling half of that of the horse. In the adult ruminant two cardiac bones are frequently found in the heart, in connection with the auriculo-ventricular rings. The left bone is much smaller than the right.

The Head of the Ox.

The difference betwixt the general aspect of the head of the ox and that of the horse mainly consists in the different extent and form of the frontal and parietal bones. The frontal bone of the horse extends but little more than half-way from the orbit of the eye to the top of the head, and above the frontal bone the two parietals, thickly covered as they are in the living animal by the temporal muscles, form the arch-shaped dome of the skull. Now, in the ox the frontal bone extends from the nose to the superior ridge of the skull, presenting a flat irregular surface destitute of muscles to cover it. In the cranium of the ox the frontal bone is well developed, and it extends from below the eyes to the back of the skull, and forms the entire forehead and crest. In the middle of the forehead is the frontal tuberosity, which is especially large in the case of those oxen which have no horns. The frontal bone is very thick, and its superior surface is flat and broad, especially in the case of the male.

Comparing for a moment the skull of the sheep and the deer, we find that the face is more markedly curved down in reference to the long axis of the skull in the sheep than it is in the deer.

Reverting now again to the frontal bone of the ox, we find that it is especially characterised by the conical osseous cores on which the horns are supported. From the sides of the crest these two processes, the horn-cores, arise, and they vary in size and in degree of curvature, although they correspond to the horns in shape. These horn-cores are porous, especially at their roots. They are, moreover, very rough, and also covered with thick

periosteum, and they contain sinuses and large canals and also foramina, through which pass arteries and veins. The horns of oxen may be used as very formidable weapons of attack, and they are, in fact, often used with terrible effect. They must be securely based on the frontal bone, and, indeed, they may be looked upon as continuations of that bone. The forehead of the bull is considerably shorter and also broader than that of the cow or bullock. In the case of some hornless cattle

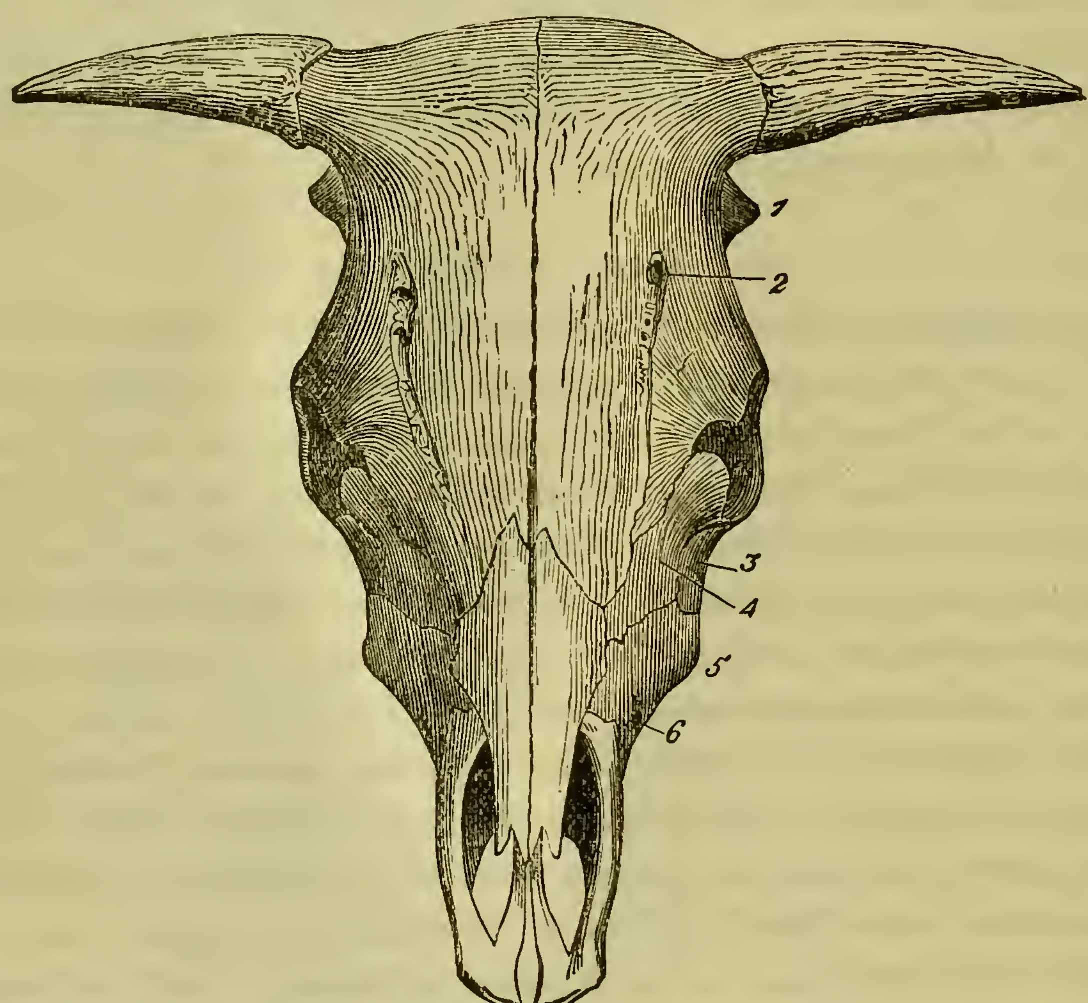


FIG. 2.—OX'S HEAD—ANTERIOR FACE

1. Mastoid process. 2. Supra-orbital foramen. 3. Zygoma. 4. Lachrymal bone. 5. Maxillary spine. 6. Inferior orifice of the supermaxillo-dental canal. (*Chauveau.*)

the frontal bones begin to contract a little above the eyes, and end in a rather narrow ridge at the top of the head. However, even these cattle use their heads aggressively, and sometimes butt one another with very great violence. Now, if the brain were situated immediately beneath the bone, the concussion might not unfrequently be highly dangerous, and even fatal. Hence the frontal portion of the skull is composed of two plates separated from each other at least an inch at all places, and in some parts more than two inches, by numerous vacuities, and

these cells extend through the whole of the bone. Moreover, we find that the vacuities in the horn-cores are continuous with the largely-developed frontal sinuses, and these, in their turn, are likewise prolonged into the parietal bones, and even into the occipital bone. In fact, the cavities extend from the extremities of the cores to the orbit, and nearly as far backwards and downwards as the foramen magnum. The two nostrils are, as it were, merged into one. Indeed, there is one continuous cavity from the muzzle to the tip of the horn and from one muzzle to the other.

Inflammation of the Frontal Sinuses.—The sinuses are lined internally by a prolongation of the membrane of the nose, and when one part of it is inflamed, the whole is liable to be affected. Consequently, nasal gleet in the ox ought to be examined and properly treated at once. After a little cough, with slight nasal discharge, a beast may rapidly become dull and drooping, and carry the head on one side. Grubs or worms may have crept up the nostril and be lodged within some of the sinuses, or perhaps inflammation of the membrane of the nose, the result of an ordinary cold, may extend along the cavity, and be more intense in some particular spot than in others. Even suppuration may supervene, and it is more common near the root of one of the horns. The veterinary surgeon either opens the skull at the root of the horn with a trephine, or cuts off the horn at its root. More than a pint of pus may escape from the orifice. The opening into the sinus should, however, be speedily closed. Occasionally the ox suffers greatly from the larva of a species of fly, which creeps up the nose and lodges in some part of the sinus. The ox is tortured much more than the sheep from this cause, and the symptoms may even resemble those of inflammation of the brain.

The supra-orbital foramina are double, situated far backwards, and continued by a groove. The frontal arch articulates with the zygoma. The processes which form the orbital arches rest by their summits on the zygomatic bone. The supra-orbital foramen is a true and frequently multiple canal. The inferior border of the frontal bone is deeply notched in its middle to receive the nasal bones. In the sheep and goat the frontal bone is relatively less extensive and strong than it is in the case of the ox. It does not ascend to the summit of the head, and

the frontal sinuses are not prolonged beyond its superior border.

The parietal bone in the ox does not occupy the anterior aspect of the head; but it joins with the occipital bone in forming the base of the neck. The parietal bone is a narrow osseous plate elongated transversely, and recurved at its two extremities, and it descends into the temporal fossa to rest upon the sphenoid bone, and articulate with the sphenoid and temporal bones. The parietal bones are small. Each is situated below the frontal crest, and extends under and supports the horn-cores. Beneath the crest posteriorly the two parietals unite by means of the inter-parietal suture; but there is never a central suture in ruminants. There are no parietal ridges. The parietal bone of the ox is not involved in the formation of the parieto-temporal canal, and it is excavated internally by cavities which communicate with the frontal sinuses. The parietal bone of the sheep and goat is relatively much larger than that of the ox, and in these animals it takes part in the formation of the parieto-temporal canal, and has no sinuses.

The occipital bone is much wider from side to side, but at the same time smaller, than the occipital bone of the horse. The occipital protuberance is obtuse, and gives rise to the superior curved lines on each side. In the case of the occipital bone of the sheep these curved lines are very marked, and they occupy the summit of the head. The basilar process is wide, short, and thick. The condyloid foramina are double and sometimes triple. The foramen lacerum is divided into an anterior foramen and a posterior one by means of the mastoid portion of the temporal bone. In the sheep the basi-occipital is square and flat, but it is longer in other groups.

The Ethmoid Bone.—In ruminants the ethmoid bone and its cells are well developed, and the great ethmoidal cell is of enormous size. The ethmoid bone has a large volute prolonged forwards, and it looks like a third turbinated bone prolonged between the two turbinated bones usually met with. It has been called the olfactory antrum or cave. The ethmoid bone is closely fixed between the adjacent bones, in consequence of the slight development of the sinuses around it.

The Sphenoid Bone.—In the ox the pterygoid processes are large and thin. The sub-sphenoidal canal is not present. The

Sella turcica is deep, and the bony projection separating it from the basilar process is very prominent. The three supra-sphenoidal canals blend to form a single wide one. There are no notches in the superior border for the passage of the internal carotid and spheno-spinous arteries. There is no pterygoid foramen, and likewise there is no foramen lacerum basis cranii, its place being occupied by the large auditory bulla; but there is a large foramen ovale through which passes the inferior maxillary nerve. The foramen lacerum orbitale and the foramen rotundum are not separated by a plate of bone. In the sheep the osseous prominence which bounds the pituitary fossa behind forms a lamina which curves forward, and is prolonged at its extremities into two points, the posterior clinoid processes.

The Temporal Bone.—In the ox, the sheep, and the goat the petrous and squamous portions of the temporal bone are always united. The zygoma is slender in ruminants. The summit of the zygomatic process only articulates with the malar bone. In the ox the condyle of the zygomatic process is very wide and large and convex. The mastoid process is large. The styloid processes are short and wide and greatly curved inwards, and broader than in the case of the horse. The parieto-temporal canal is very large, and it is entirely excavated in the temporal bone. Its superior or internal extremity opens above the petrous portion in an excavation, which represents the lateral cavity of the parietal protuberance in the horse. At its inferior extremity it always shows several orifices. The mastoid crest is united with the upper root of the zygomatic process, and it is prolonged below to the mastoid protuberance, which is very large. The external auditory meatus is small, and directed slightly downwards. The tympanic bulla exists in ruminants, but it is not markedly developed. In the case of the sheep and goat the mastoid process is scarcely distinct from the crest, and the mastoid portion of the bone is only at a late period united with the petrous portion.

The superior maxilla is shorter but broader than that of the horse, the maxillary spine consisting of, or rather being represented by, a rough protuberance, which is not continuous with the zygoma. In fact, in the ox, sheep, and goat the maxillary spine does not directly join the zygomatic crest. A curved line, whose concavity is directed posteriorly, effects the union between

these two parts. The inferior orifice of the dental canal of the superior maxilla or infra-orbital foramen is situated opposite the first molar tooth. With the exception of the camel, no ruminant has incisors in the upper jaw. There is no fissure for the formation of the palatine canal. The cavity of the sinus is more spacious than in the horse, and in the case of the ox only it is prolonged between the two laminæ of the palatine roof. There is no alveolus for the tusk.

Premaxillary Bone.—The premaxilla is broad. The inferior or chief portion of this bone is flattened before and behind, and devoid of alveoli in its external border. It is rarely united with the adjacent bones, and is never, in the case of the smaller ruminants, articulated with the nasal bone. The præmaxillæ do not reach the nasals in the Saiga antelopes, though they do in the case of other antelopes. The Saiga antelope has a very short nasal region; but it is prolonged by means of cartilage anteriorly. In fact, the nasal bones are very short, and they end near the orbits in the Saiga antelope.

In the ox the nasal bones are rather long, but shorter and broader, and not so firmly articulated as are those of the horse. The superior extremity of each nasal bone is held in a groove in the inferior border of the frontal bone. The lower end presents two points having a notch between them. Of these two points the inner one unites with its fellow to form one projection, so that in the articulated skull the nasal peak presents three points, but in the smaller ruminants only two. The palate bone is large and very well developed in the ox, and it is noted for the breadth of the palatine portion of its external surface. The palatine canal is entirely channeled out in its substance. The palatine crest is very thin and elevated. The lachrymal bone appears on the face, is large, and at the bottom of the orbit it forms a large protuberance, which is crossed by the maxillary sinus. The orbital plate of this bone is thin and fragile. This bone has not its foramen situated externally. As was said above, the lachrymal bones do not reach the nasals in the case of the goat, so that in this animal there is a vacuity left between these two bones; but this is not the case in the sheep.

The malar bone is well developed. It is bifid posteriorly. The superior branch meets the orbital process of the frontal bone, and the posterior branch joins the zygomatic process of

the temporal bone behind the orbital fossa, being formed by the union of the posterior borders of the palatine and pterygoid bones, and the pterygoid process of the sphenoid bone. The posterior nares are very narrow, and situated behind the superior maxillæ, and not between those bones. The pterygoid bones are large, and usually close an opening which is left between the sphenoid and palatine bones. The superior turbinal is small, the inferior turbinal being largely developed. The vomer is very large, and rests on the anterior half of the maxillary suture. The inferior maxilla is longer, but less massive than in the horse. The neck is more constricted, and the symphysis seldom becomes completely ossified. There are eight small alveoli in front for the incisors and canines, the latter being close up to the former. The condyles are small and convex in their short diameter, but slightly concave in their long diameter, thus allowing of a considerable amount of lateral motion. The coronoid processes are long, and the sigmoid notches are very deep. The hyoid bone has one cornu and two cornicula on each side. The two cornua or stylohyals are suspended from the temporal bone. The spur process is small and blunt.

SECTION II.—LIGAMENTS AND MUSCLES.

In the ox the dorso-lumbar supraspinous ligament is composed of yellow elastic tissue, and anteriorly is expanded and attached to the sides rather than to the summits of the neural spines of the vertebræ. The inferior common ligament is very strong, and the intervertebral discs are thicker than those of the horse. The ligamentum nuchæ is also stronger, the weight it has to bear being greater. The sternal ribs articulate with their cartilages by means of true diarthroses, and they are supplied with synovial membranes. The sternum has an inferior common ligament, and the presternum, or manubrium, articulates with the mesosternum by a diarthrosis. The transverse lumbo-sacral and interlumbar articulations are peculiar to the horse, and not present in the ox. With regard to the ligaments of the hind limb, the pubo-femoral ligament is also wanting in the case of all the domesticated animals except the horse, and it is owing to the absence of this ligament that the larger ruminants can

deliver those sweeping circular blows with the foot, known by the name of "cow kicks." There is more motion in the tarsus of ruminants, owing to the greater mobility of the astragalus, which glides upon the calcaneum, the cubo-cuneiform bone, the tibia, and the malleolar bone. In the elephant there is no round ligament, and the femur, instead of being when at rest inclined downwards and forwards, is almost perpendicular. This accounts for the peculiar contour of the haunch in that animal.

In ruminants, the panniculus carnosus in the cervical region is for the most part aponeurotic, and there is a muscle resembling that one which is known as the sterno-maxillaris of the horse, which is sometimes looked upon as its inferior fleshy portion. In the head, the panniculus carnosus resembles that of the horse, but there is an expansion of it in the frontal region which is called the *frontalis* muscle.

In the head, the palatine ridges being closer together than is the case in the horse, the pterygoid muscles originate nearer to the middle line of the head, and thus the contraction of them produces more lateral motion in the lower jaw than there is in that of the horse. There is no digastric muscle in the domesticated animals other than the horse. The muscle which represents it has only one belly, and in the ox this muscle is joined to its fellow on the opposite side by a small, square, transverse muscle. The masseter and temporalis muscles are both less strong. The frontalis muscle, above spoken of, passes from the root of the horn-core to the upper edge of the orbital fossa. It is a flat, thin muscle, and it blends with the external levator of the eyelid. The levator labii superioris alæque nasi is not present in the smaller ruminants, and in the ox it differs from that of the horse in that the anterior division, instead of the posterior one, covers the dilatator naris lateralis, and also that it covers the nasalis longus as well. Two accessory muscles arise in common with this nasalis longus, and they are inserted in the upper lip. The dilators of the nostril, except the lateralis, are wanting. The zygomaticus has a long tendinous origin, which reaches up to the zygoma. The long tendon of insertion of the depressor labii inferioris is not present. The hyoideus magnus has a long tendinous origin, and it forms no sheath, there being no mesian digastric tendon. The lachrymalis is closely blended above with the anterior border of the orbicularis

palpebrarum, and is more strongly developed and thicker than in the case of the horse.

The Trunk.—The muscle which seems to correspond to the sterno-maxillaris of the horse is looked upon by Chauveau as representing the inferior fleshy band of the panniculus carnosus. It is attached above to the fascia of the masseter muscle, and sometimes it may be traced to the zygoma. If this view is the correct one, it would appear that the sterno-maxillaris is represented by the sterno-suboccipitalis, a muscle which is inserted on the basi-occipital bone, in company with a tendon of the levator humeri. The sterno-thyro-hyoideus is larger than in the horse, and is not digastric. The rectus capitis anticus major is covered by the trachelo-atloideus, a flat muscle which unites the atlas inferiorly to some of the succeeding vertebræ. The levator humeri attaches itself anteriorly to the mastoid process, to the posterior surface of the occipital bone and the ligamentum nuchæ, to the basi-occipital bone, together with the sterno-suboccipitalis, and to the wing of the atlas by a tendon separate from that of the splenius and trachelo-mastoideus. The splenius muscle in the case of ruminants is very small. In the camel, according to Cuvier, it does not exist, or, if it does, is so small as to escape observation.

The trapezius and serratus magnus are largely developed, and the intercostals and levatores costarum, of course, vary in number with the ribs. The pectoralis anticus is small, and considerably blended with the transversus. The abdominal tunic is large and very thick, and, in fact, it may be said that its development is always proportional to the magnitude of the abdominal viscera. The lineæ transversæ of the rectus abdominis are very well marked. The obliquus internus is large, and it fills up the space between the ilium, the last rib, and the lumbar vertebræ. The fascia transversalis is more marked than is that of the horse. The diaphragm in ruminants is thick and strong, and is proportionate to the weight of the abdominal viscera. The crura of the diaphragm are long and large, and the periphery is attached more anteriorly than in the horse. In the camel the diaphragm usually contains a small bone.

Fore Limb.—The extensors of the metacarpus are disposed as is the case in the horse, with the exception that the tendon of the obliquus is inserted into the great metacarpal bone. The

extensor pedis is divided throughout its length, thus giving rise to an external muscle, the extensor communis digitorum, and an internal one, the extensor proprius internus, the former of these two muscles being rather larger than the latter. The tendons of these muscles run down the metacarpus in company, and at the commencement of the digits that of the extensor communis bifurcates, a portion being inserted into the pyramidal process of each distal phalanx. The tendon of the extensor proprius internus receives slips from the suspensory ligament about the middle of the first phalanx, and is attached to the mesial and outer surface of the internal distal phalanges. The extensor suffraginis is represented in ruminants by the extensor proprius externus, and it differs from the former muscle of the horse in being thicker and stronger, and in being inserted in the same manner as the internus. These three muscles are all extensors, but the communis is also an approximator, while the proprii are diverters or expansors of the digits. The flexor perforatus is a double muscle, but unites to form a single tendon, which divides, and each part behaves as the single portion in the horse, being, however, assisted in the formation of the sheaths for the perforans tendons by two strong slips from the suspensory ligament which correspond to the check ligament. The check ligament may be said to be attached in the ruminant to the perforatus tendon only. The tendon of the flexor perforans also divides, the two parts passing through the sheaths formed as above described, and ending in a manner similar to that of the horse, becoming, however, blended with the plantar cushion of the foot, and the inferior interdigital ligament.

Hind Limb.—The gluteus externus is closely blended with the triceps abductor. The gluteus maximus is nearly covered by the compound muscle and that of the fascia lata, and is smaller than in the horse, while the gluteus internus is much larger. The tensor fasciæ latæ and triceps abductor are firmly united over the region of the trochanter major, the former muscle being largely developed, while the latter has no femoral attachment. The rectus parvus is absent. The biceps rotator tibialis has no origin from the sacrum. There appears to be no proper pyriformis muscle, but there is a muscle similar to it outside the pelvis. The tendon of the obturator internus passes through the obturator foramen. The fibrous portion of the flexor meta-

tarsi and the extensor pedis of the horse have, in the case of the ox, a common origin, giving rise to three large muscles, of which the external one is the extensor communis digitorum, and the internal the extensor proprius internus, the tendons of these two terminating as in the fore limb. The third of these three muscles is situated in front of and a little to the inner side of the others. It is a flexor of the metatarsus, and represents the fibrous portion of the flexor metatarsi in the horse, forming a sheath or ring through which the tibialis anticus, a muscle representing the fleshy portion of the same, passes. The peroneus is the extensor proprius externus, and it is attached distally, as in the case of the fore limb. A muscle, the peroneus longus lateralis, has no representative in the horse. It arises deeply from the external part of the head of the tibia, and ends in a long slender tendon, which winds obliquely over that of the proprius externus at the tarsal joint, and after pursuing a tortuous course round the outside of the joint, is inserted into the small cuneiform and metatarsal bones. The gastrocnemius internus of the ruminant is thicker in the fleshy portion than that of the horse, and the flexor perforans is more clearly divisible into two parts.*

SECTION III.—INTERNAL ANATOMY.

The Organs concerned in the Process of Digestion.

As our readers probably know quite well, the organs which are concerned in the process of digestion in ruminants are of a characteristic and very complex kind. For example, the stomach is composed of no less than four compartments in most ruminants, and each one of these has its own special functions. We shall describe the stomach in detail later on; but we may say here that, having regard to the complexity of the digestive canal, there is no reason for surprise in the fact that ruminants are liable to become affected with certain peculiar kinds of diseases which are connected with the special features of their

* For the above brief account of Ligaments and Muscles we are, in some degree, indebted to that valuable work, Strangeway's *Veterinary Anatomy*, revised by Vaughan.

system of alimentation and means whereby their food is converted into material capable of being absorbed into the blood-stream. Ruminants, as a matter of fact, do usually extract their nourishment from food which is comparatively innutritious in nature. Consequently they have to take rather large quantities of food, and accordingly the digestive canal in this class of animals is specially constructed so as to be capable of dealing with considerable amounts of ingested substances. Indeed, it may seem wonderful how the bulky bodies of herbivorous animals can be maintained by the food supplied to them. On the other hand, the carnivorous animals, such as the lion, tiger, cat, dog, and so forth, have much less difficulty in converting the flesh which they consume into the flesh and blood of their own bodies, and hence their digestive canals are of a more simple kind.

It may be said that vegetable material requires a longer time in order to be digested than do other substances. For instance, in man vegetables are not fully digested in the stomach; and in the case of a person who had an artificial anus at the end of the small intestine, vegetables were found even there to be only incompletely digested. Hence in ruminants, herbivorous marsupials, and herbivorous quadrumana we find a complex stomach, a long small intestine, a large-sized cæcum and a spirally-shaped colon. Again, the dugong, the sloth, and the manatee have stomach and intestines complex, though in different ways. Again, the dormouse, wombat, and beaver have little or no complexity, but have a gland at the side of the stomach. Finally the perissodactyle ungulates have the stomach simple but the colon and cæcum sacculated. All these animals are herbivorous, and we see that special arrangements are present in order to facilitate the digestion of vegetable matters. In this connection it is well to bear in mind also that vegetable material does not putrefy so rapidly as fleshy substances do, and hence it is not necessary that it should be so quickly got rid of.

Again, human beings are omnivorous. Our food consists of both animal and vegetable material, and under the general circumstances of healthy nutrition it is most advisable that we should take a mixed diet. Indeed, there can be no doubt that the wisest and best plan is for us to live on fish, flesh, or fowl, as well as vegetables; and we may add that a fair amount of water per diem is requisite, and that we ought to allow a sufficient

time for the process of digestion of each meal before we undertake hard work of any kind, especially such as is of a mental character. As an example of the kind of ailment which is essentially characteristic of ruminants, we may here mention a disorder which is well known to all who have to do with cattle and sheep under the name of hoven or tympanitis—a derangement which we shall in due course consider, and one which, as we shall soon see, is due to a distension of the rumen with gas resulting from the fermentation of undigested food contained therein. As another instance of a derangement peculiar to ruminants, we may mention that food in the case of these animals may be found to be impacted betwixt the folds of the omasum, though we must not forget that, even under the ordinary circumstances of health, hard plates of more or less completely digested material are found lying between the leaves of that stomach.

As our readers know, that large class of herbivorous animals, to which the name of ruminants has been given, are so designated because it is their habit to hastily swallow a large mass of food into the capacious paunch or rumen, and then to chew it leisurely at a convenient subsequent time. These animals, when in the wild state, have to rely upon their quickness of sight, their acute powers of hearing, and their great agility in evading their enemies. They congregate together in large numbers, and one or more of the herd may be observed to keep on the watch, and also to make signals to their companions if any danger is at hand. If so, these timid creatures seek safety in flight, and escape by fleetness of limb. In the domesticated state this power of speedy flight is not possessed ; but the special features of the digestive system are far too definitely fixed to be altered very appreciably, although the power of swift motion is almost entirely lost.

As compared with animals such as the horse, cattle may be said to be of rather a plethoric habit. Under suitable conditions they rapidly become fat. Another point about ruminants is that aperient medicines may be given with far greater freedom to them than to certain other animals, as indeed they also may be administered more freely to the pig and dog than to the horse. Again, we find that the horse suffers frequently from flatulent colic in the large intestines, owing to this portion of the alimentary

canal in the horse containing a considerable amount of food which is liable to undergo fermentation. In the ox, on the other hand, as also in the sheep, we often meet with distension of the first stomach, or rumen, a condition known as "hoven," which likewise arises from the disengagement of gas. Whereas, then, in the case of the horse it is in the large intestines that this affection occurs, in the case of ruminating animals it is in the rumen, or paunch. Again, whereas inflammation of the bowels may not uncommonly bring about a fatal issue in the horse in the course of a few hours, the same affection may be continued for as long as a fortnight in the case of an ox before death supervenes. Similarly, many other inflammatory affections kill the horse within a few hours, whereas they may be protracted for days or even weeks in oxen.

Again, ruminants are possessed of powerful tongues, by means of which they can take into the mouth long and thick tufts of grass. The tongue of the ox is rough, and studded with papillæ, which are directed backwards. The upper lip is short and thick, and the incisor teeth, situated in the front of the lower jaw, are used for cutting the food pressed against the pad. The herbage is then slightly masticated by means of a few strokes of the molar teeth, mixed with the saliva and other secretions of the mouth, then swallowed and passed down the œsophagus into the rumen, or paunch, in which stomach it is tossed about a little and to some extent mixed with the fluid secreted by the glands contained in the walls thereof. We may here state that some of the water which is drunk passes into the rumen. Some of the food is conveyed from the rumen through the valvular opening into the reticulum, in which stomach it is mixed with mucous fluid. The finer part of the pabulum is then passed to the third compartment, or manyplies, while the larger portions of the food are at a convenient time regurgitated into the mouth in order that they may be masticated over again at the animal's leisure. In the process of chewing the cud the camel moves its jaws laterally from left to right and from right to left, whereas the ox gives a rotatory movement.

Regurgitation is effected by means of the muscular contraction of the walls of the reticulum, the relaxation of the œsophageal pillars, and the anti-peristaltic action of the œsophageal walls.

After having been chewed for the second time, the food is then again swallowed, and a portion of it now passes into the rumen, the rest down the œsophageal canal to the manyplies. Here the solid material is drawn between the leaves of that organ, while the liquid portion flows on to the abomasum. Then the digestive material is at length passed into the intestinal canal.

We must bear in mind that rumination, or chewing the cud, is entirely under the control of the will, and that it is a process which may very easily be disturbed. Hence great care should be taken not to interfere with an ox or a sheep when reclining and engaged in calmly chewing the cud.

In the winter time some owners of stock have their beasts inspected at about half-past 8 o'clock, and they are often made to stand up in order that it may be seen if they stretch themselves or not, the fact of them stretching themselves being considered sufficient evidence that they are well. However, it is important to remember that one of the best signs of health is the chewing of the cud.

The processes of digestion comprise all those changes whereby the nutriment is extracted from the food and rendered capable of absorption. The food, while it remains in the stomach, is subjected to slow movement as a result of the muscular motion of that organ. As it is gradually rolled about, the mass of food is rendered partly soluble by slow degrees at its surface. During the process of digestion the mucous surface of the stomach is more freely supplied with blood and changed from its usual pale hue to a bright red colour. The food is transformed into chyme in the stomach, and this semi-fluid material accumulates at the pyloric orifice. This, then, opens and allows the chyme to escape into the small intestines into which the bile also flows. Here it undergoes further change, and the soluble ingredients are absorbed by the blood-vessels and lacteals in the walls of the intestinal canal.

The lips of the ox are thick and rigid, and only slightly mobile and prehensile. A large portion of the outer and front part of the upper lip, including the part between the nasal openings, is devoid of hair, and it constitutes the muzzle. It varies in colour, but in healthy animals it is always moist. It is covered with papillæ and with the orifices of the ducts of the subcutaneous glands which moisten it by means of their

secretion. The lips of the smaller ruminants are thin and very mobile and prehensile. The upper lip is divided in front by a median fissure.

The cheeks of ruminants are provided, on their inner surface between the angle of the lip and the first molar tooth with numerous large long conical papillæ which point backwards. The roof also of the mouth is covered with rough and strongly reverted papillæ. Posteriorly a row of these papillæ runs along the level of the upper molars. Small round papillæ are also present. The hard palate is large, its posterior third being smooth. The anterior two-thirds are covered with straight transverse bars, which are denticulated, the free edges of the bars projecting backwards.

The ox is provided with a hardened pad, which takes the place of the upper incisors. Behind this pad of cartilage by which the upper incisors are replaced, there is, in the middle line, a mark, which resembles the letter T, with the normal directed backwards, and at each extremity of the transverse line is the oral opening of Jacobson's canal. The soft palate is not so large and pendulous as that of the horse. The isthmus faucium is always open, thus permitting the animal to breathe through the mouth, and allowing the upward passage of food. The tonsils probably are represented in ruminants. The tongue of the ox is much modified and raised up. Its muscles are well developed; it is prehensile, and it has great latitude of movement. Moreover, it is much rougher, shorter and thicker than is the tongue of the horse, and it is pointed at the tip. Again, the papillæ are better developed, and the filiform papillæ are very large and numerous near the apex. The papillæ circumvallatæ are arranged in two rows, one on each side of the base, and there are about ten of them on either side. Between the lower border of the tongue and the sides of the lower dental arch there is a row of conical papillæ, similar to those on the cheek. The tongue of the smaller ruminants is very delicate. The parotid gland is small and red, the duct follows a similar course to that of the horse, but enters the mouth much more posteriorly. In small ruminants it crosses the masseter muscle externally. The submaxillary gland is very large and of a yellow colour. The duct of Wharton opens close to the incisors, the papillæ surrounding the openings being

lodged in an elliptical fossa. The sublingual gland is divided into two parts, the posterior of which opens by a single duct (the duct of Bartholini) close behind the opening of Wharton's duct, and the anterior by a row of ducts as in the case of the horse.

With the exception of the camel and the llama, which are not as a rule domesticted in Europe, the ruminant is possessed of neither incisor nor canine teeth in the upper jaw. The former are, as was said above, replaced by a thick cartilaginous pad which is covered by the mucous membrane of the hard palate. In the lower jaw there are six incisor teeth and two canines, the latter closely resembling the incisors in shape and being situated immediately behind and outside them. Some speak of the incisors as eight in number, *i.e.* they look upon the canines as incisors. These teeth are chisel-shaped, rather like the human incisors, but they have a curved contour, being convex in front and concave behind. The whole of the crown is covered with enamel, the neck is small and constricted, and the teeth are arranged in the jaw in an almost horizontal position, forming a radiating or fan-like series. They are not firmly fixed in the alveoli, but have a certain degree of mobility, thus preventing injury to the cartilaginous pad above. The molars have compound tables like those of the horse, but the teeth are much smaller and cuboid in shape.

The dental formula of most ruminants is:—

$$\left.\begin{array}{l}\text{Upper jaw}\\\text{Lower jaw}\end{array}\right\}\ \text{incisors } \frac{0}{3},\ \text{canines } \frac{0}{1},\ \text{premolars } \frac{3}{3},\ \text{molars } \frac{3}{3},\ = 32.$$

That of a camel is:—

$$\left.\begin{array}{l}\text{Upper jaw}\\\text{Lower jaw}\end{array}\right\}\ \text{incisors } \frac{1}{3},\ \text{canines } \frac{1}{1},\ \text{premolars } \frac{3}{2},\ \text{molars } \frac{3}{3},\ = 34.$$

The pharynx is large, but the muscles composing it are not very distinctly separable. The œsophagus is well developed, and its muscular walls are red throughout. It expands at its junction with the stomach, so that its termination is funnel-shaped. The muscular fibres are capable of peristaltic and of anti-peristaltic contraction, and so induce both a downward and an upward motion of the contents of the tube.

The muscular wall of the œsophagus is strong, and inasmuch as, preparatory to the re-mastication of the food, the bolus is

projected with great force it would probably fly out of the mouth if the above-mentioned papillæ were not present. In the camel these papillæ are situated on the tongue and on the palate. In the general way in camels there are two ridges from the anterior nares whereby moisture is carried from the

FIG. 3.—THE TEETH OF THE OX.

1. Upper Jaw, with *a* the friction surface, *b* the external surface. 2. Lower Jaw with *a* the dental tables, and *b* the external face.

nose to the mouth. This is an example of adaptation. The camel has also a flap hanging from the palate which aids in retaining the moisture in the mouth. In the case of the male camel, during the rutting season, this flap can be blown out.

The giraffe differs from other ruminants in that it is provided with a long tapering muzzle. The giraffe also has a very long

tongue, the muscles of which are very large but have the same arrangement as is usual. In the giraffe the ninth pair of cerebral nerves (the hypoglossal) is very large, and these nerves are also wavy, thus enabling the tongue to be extended without straining them.

In all ruminants the parotid gland is large, and as a group the salivary glands are relatively larger than in the case of the horse. In the œsophagus there are two layers of muscle, the one layer in these animals running spirally in one direction and the other in the contrary way. Moreover, in correspondence with their specially marked muscular powers, the fibres of these muscles of the œsophagus are striated, although they are for the most part unstriated in other animals. The œsophagus of the giraffe is, as must needs be the case, of great length.

The ruminants (ox, sheep, deer, camels, and giraffes or camelopards), in correspondence with their requirements, possess, as we have said above, stomachs of considerable size and great complexity. Bovidæ especially have a complex stomach divided into four compartments, whereas in the case of many ruminants there are only three divisions of this organ. The average collective capacity of the four compartments in an ox is not less than 55 gallons, and thus the greater part of the abdominal cavity is taken up by them. The stomach of a ruminant is a very complex organ, and consists of four separate compartments which differ greatly in size, in form, and in the disposition of their mucous coats. The first of the four compartments is the rumen or paunch, the second is the reticulum or honeycomb, the third is the omasum, psalterium, or manyplies, the fourth is the abomasum or rennet, or true digestive stomach. The four cavities form a short continuous chain.

In Moschus (the musk-deer) there are three divisions only, namely, paunch, reticulum, and abomasum, there being no true psalterium. The rumen has a conical process below in the sheep and musk-deer. The reticula are very shallow in the musk-deer (*Moschus*). Moreover, the opening which leads from the rumen to the reticulum is very large in these animals. Hence in them the stomach as a whole is not so complex as it is in most ruminants.

The first three compartments have but little to do with the essential process of digestion, being concerned chiefly in macerat-

ing and preparing the food, and being similar in point of function to the cuticular portion of the stomach of the horse. In the adult ox the rumen, into which the gullet opens, is very large, much the largest compartment of the four, and it occupies about three-fourths of the abdomen. It constitutes about nine-tenths of the whole mass, and into its cavity is received the hastily swallowed and imperfectly masticated food. The rumen is situated on the left side of the animal's body, and to its left side

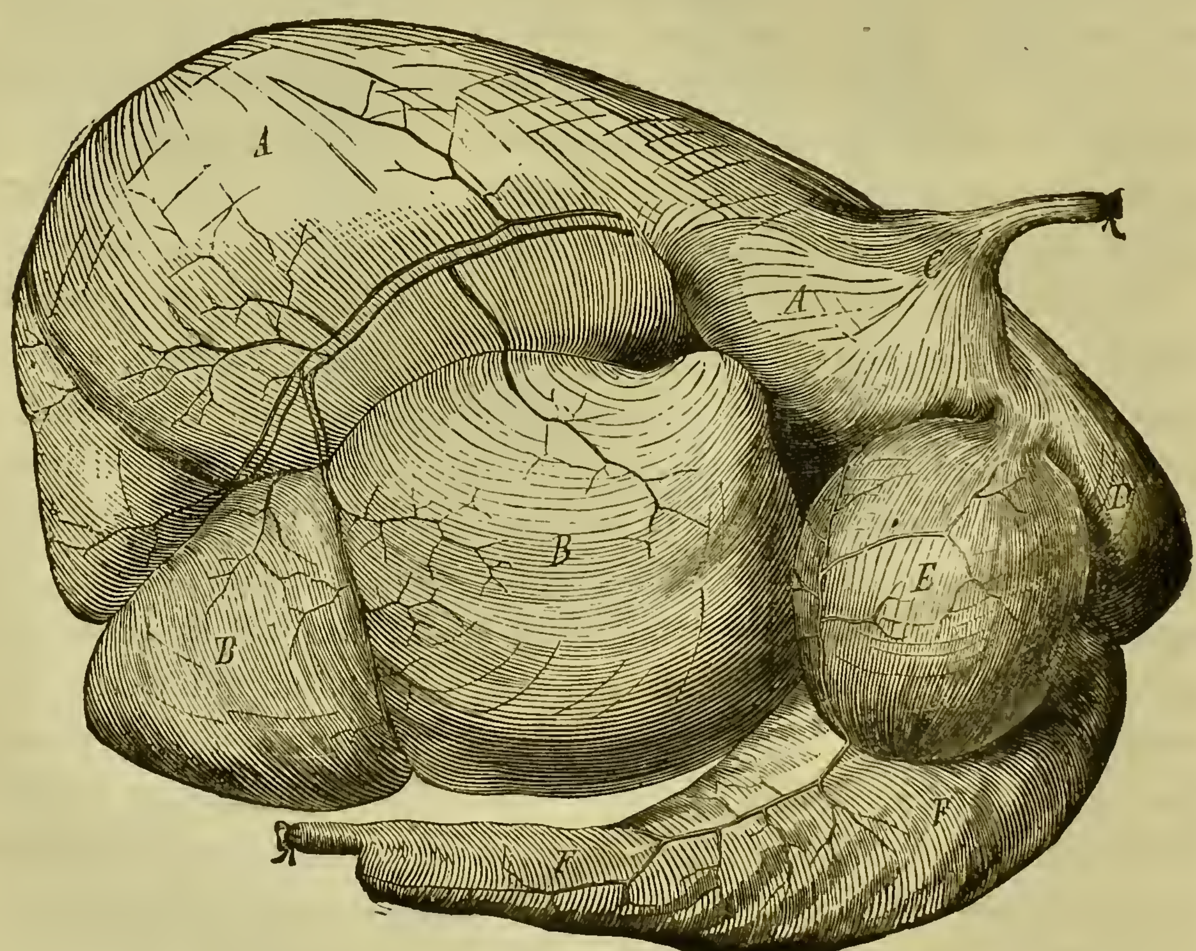


FIG. 4.—STOMACH OF THE OX SEEN ON ITS RIGHT UPPER FACE, THE ABOMASUM BEING DEPRESSED.

A. Rumen, left hemisphere. B. Rumen, right hemisphere. C. Termination of the œsophagus. D. Reticulum. E. Omasum. F. Abomasum.

the spleen is attached. It inclines obliquely downwards from left to right, and is elongated from before backwards. In front of the rumen lies the reticulum, while the omasum and the abomasum are situated on the right.

When it is filled with food, the rumen may be seen above the level of the animal's spine. The rumen has three tunics, an outer or serous coat, a muscular coat, and most internally a mucous coat, in which the glands are imbedded. The internal surface of the rumen is rough, and covered with hard epithelium,

the mucous coat being covered by numerous little papillary prolongations, some of which are conical, others foliaceous, while others are fungiform.

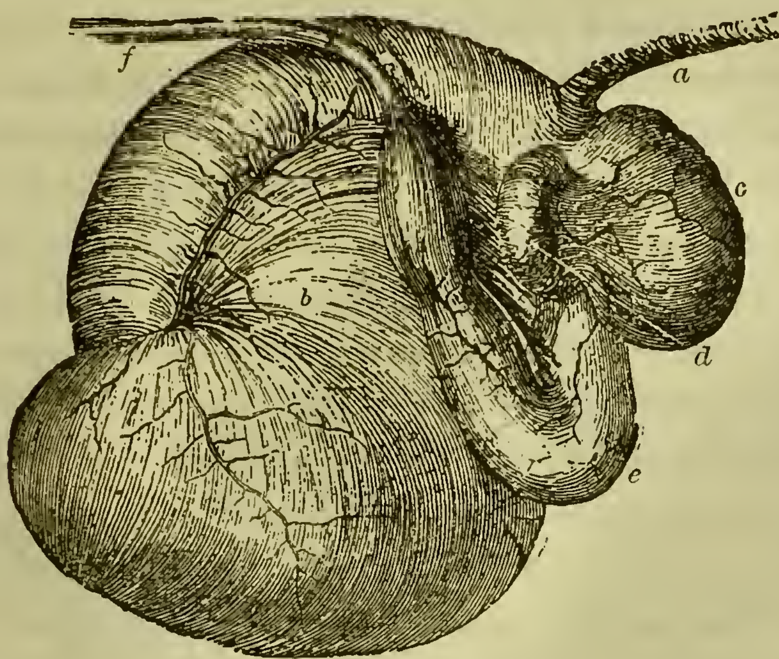


FIG. 5.—RIGHT VIEW OF THE STOMACH OF THE OX.

a. Gullet. *c.* Honeycomb. *e.* Rennet, or Reed.
b. Paunch. *d.* Manyfold. *f.* Small Intestine.

(Simonds.)

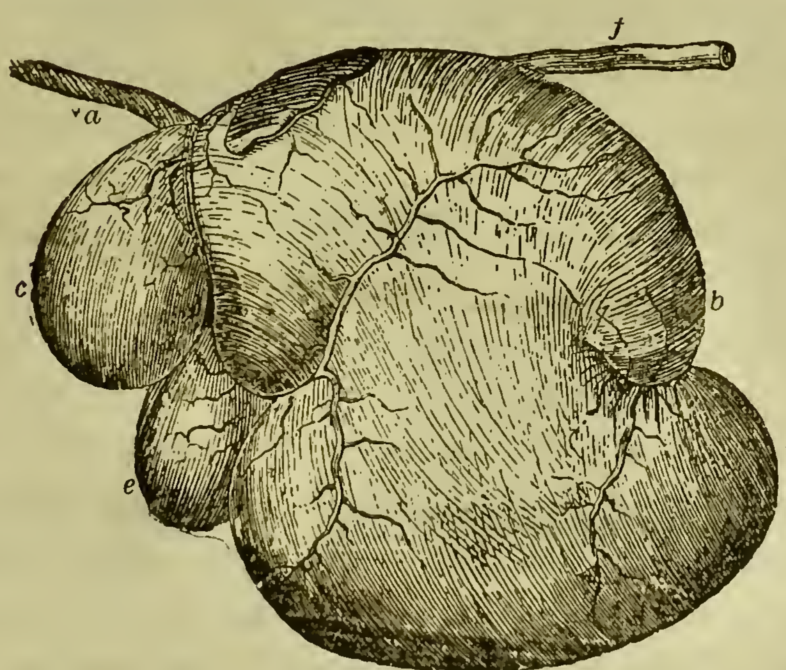


FIG. 6.—LEFT VIEW OF THE STOMACH OF THE OX.

The Manyfold is not seen in the picture.

(Simonds.)

The letters are explained above.

In the case of the young animal while it lives upon milk, this stomach is of no use. Indeed the milk passes directly from the œsophagus into the psalterium and then into the abomasum.

The paunch is the largest of the four compartments in adult life. It has a thick muscular coat.

The surface of the rumen is divided into two hemispheres by slight grooves which deepen towards the extremities. The sides are smooth, thick, and rounded. The extremities are divided by a deep fissure into two lobes. The two fissures mentioned divide the rumen into a right and left sac. Of these the right sac is the shorter and it is covered in the greater part of its extent by the peritoneal omentum. The left is curved on the right at both extremities, and above it receives the insertion of the œsophagus. Anteriorly it is also continuous with the second compartment. The anterior extremity has the second and third compartments in front of it, and it lies near the diaphragm. The posterior extremity is contained in the brim of the pelvic cavity, where it comes into proximity with the glinto-urinary organs. The superior surface comes into relation with the intestines. The inferior surface rests upon the floor of the abdominal cavity. The left side has the spleen attached to it, and it is in contact with, and attached by cellular tissue to, the wall of the lumbar region of the abdomen. The right side is in relation with the fourth compartment in the right hypochondriac and lumbar regions, and it is embraced by coils of the intestines.

On its internal surface the rumen is incompletely divided into four sacs by fleshy pillars. The chief of these are the anterior and posterior, and they correspond to the two fissures. Processes from these run from side to side and correspond to constrictions on the outer surface. Hence, in front, the right and left sacs are formed, and the right and left conical sacs behind. The walls of the rumen, like those of the other compartments, consist of three coats, an external serous one, a continuation of the peritoneum which envelopes the entire organ, with the exception of the place where it comes into contact with the lumbar region. The middle coat is thick and composed of muscle, and it is an extension from the œsophageal fibres. The internal mucous coat is cuticular, papillated, and covered with thick epithelium. These papillæ are leaf-like, conical, or fungiform, but those which are leaf-like are by far the most numerous. The opening of the œsophagus into the rumen and that of the rumen into the reticulum are both situated at the anterior extremity of the left sac. The superior

or œsophageal opening is prolonged over the small curvature of the second compartment by the medium of the œsophageal canal. The inferior opening is large and it communicates with the reticulum. Laterally and inferiorly it is circumscribed by the free border of a kind of valve which is formed by the walls of the rumen together with cells of the second compartment.

This second stomach, or reticulum, or honeycomb, is the

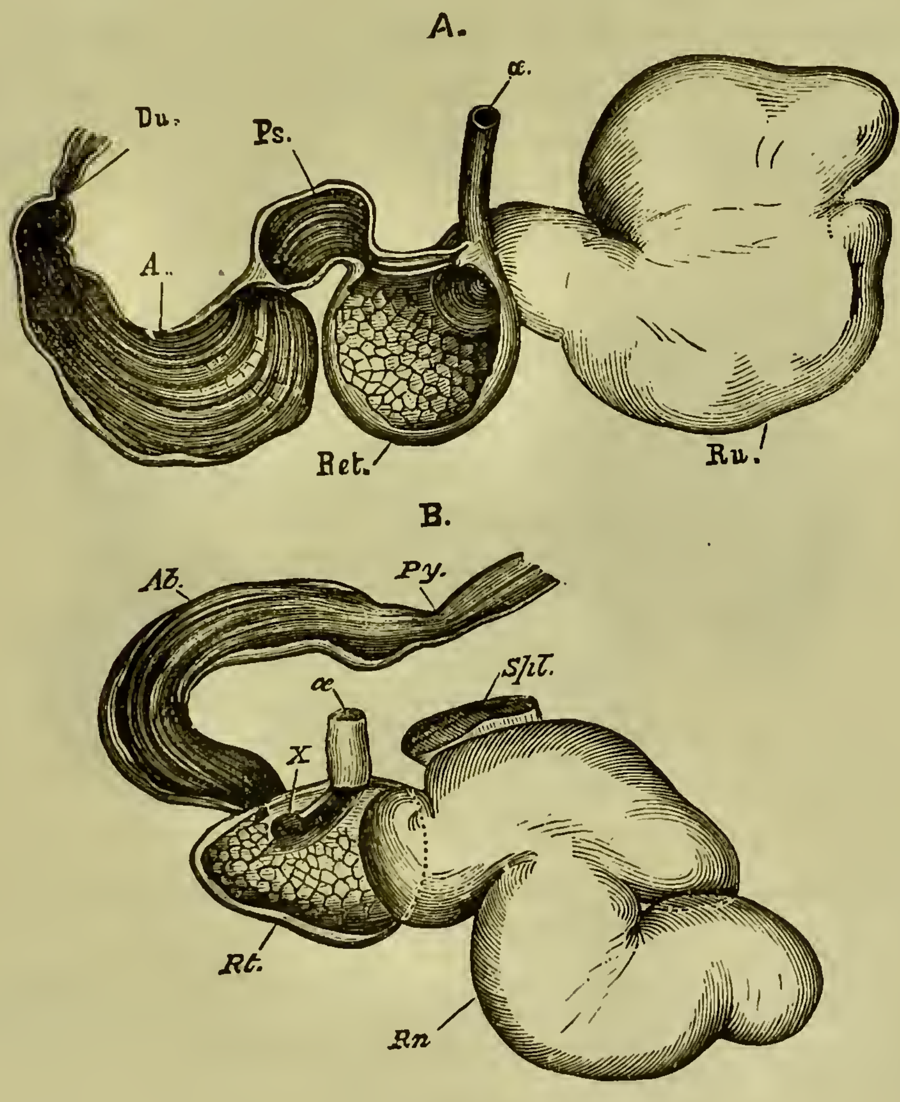


FIG. 7.

A. The Stomach of a Sheep. B. The Stomach of a Musk Deer. Œ. Gullet; Rn., Paunch; Ret., Honeycomb; Ps., Psalterium; A., Ab., Abomasum; Dn., Small Intestine; Py., Pylorus. (After Huxley.)

smallest compartment of the four into which the complex stomach of the ox is divided.

This stomach varies greatly. In the case of the reindeer and the giraffe there is but very little reticulation. The reindeer indeed needs little or no actual water, since the food it lives upon contains much congealed water. The giraffe, too, eats moist leaves. During lactation the second stomach is small. It is slightly bent upon itself, elongated from side to side, and placed

transversely between the posterior surface of the diaphragm and the anterior extremity of the left sac of the rumen. It derives its name Reticulum from the net-like (*retis*, a net) character of its internal coat, and it is situated under the termination of the gullet. It is about one-sixth part of the size of the paunch, to which it is attached in front. The interior of this second stomach communicates with the left sac of the paunch; and it communicates with the manyfold (as shown in the illustration) by an opening eight or ten times smaller than the opening into the paunch. It is found that the foreign bodies so frequently swallowed by ruminants are usually lodged in the honeycomb.

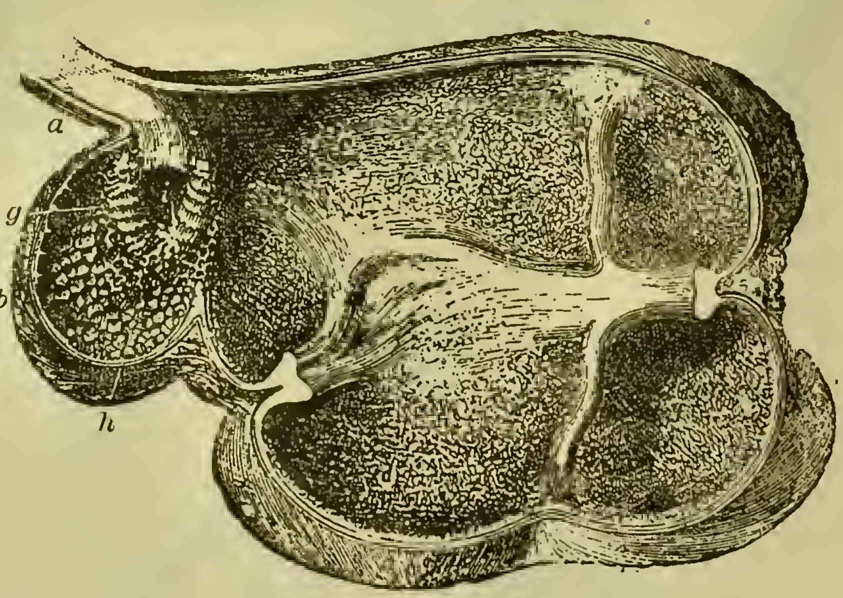


Fig. 8.—The Paunch and Honeycomb of the Ox, Laid Open, by Removing the Left Side.

a. The Gullet; *b.* The Honeycomb; *c.* The anterior pouch of the Rumen; *d.* The Middle; *e.* The Postero-Superior; *f.* The Postero-Inferior Compartment; *g* and *h.* The Pillars of the Œsophageal Canal; *i.* The Entrance into the Manyfold. (Simonds.)

The opening into the manyfold is connected by a groove or kind of gutter, which appears to continue the gullet into the interior of the stomach.

The anterior surface of the reticulum adheres to the centre of the diaphragm by means of cellular tissue, and its posterior surface is united to the anterior extremity of the rumen. The inferior convex curvature is situated in the epigastric region, while the superior curvature which is concave comes partly into relation with the small curvature of the psalterium. The left extremity of the reticulum is separated from the rumen by a fissure, in which runs the inferior artery of the reticulum. The

right extremity forms a round cul-de-sac, and it comes into relation with the base of the fourth compartment. As regards the interior, it is to be remarked that the internal surface of the reticulum is divided into polyhedral cells by means of folds of the mucous membrane, thus presenting the appearance of a honeycomb. These folds have papillæ upon them, and their edges are serrated. These cells are further divided by secondary partitions. Mucous follicles open on the internal surface. The reticulum opens into the left sac of the rumen, and it also communicates with the œsophagus, and also with the psalterium.

The communication with the œsophagus on the one side and with the psalterium on the other is effected by the medium of the œsophageal canal, a sort of continuation of the œsophagus, which begins at the cardiac orifice, passes along the roof of the reticulum, and enters the third compartment by a circular opening. The sides of this canal consist of two movable lips, the œsophageal pillars. They are continuous with the muscular wall of the œsophagus and are attached by one border to the superior wall of the reticulum, the other border being free. As they approach the opening into the third compartment, they gradually become thicker and project more markedly. At the other extremity, where the canal enters the rumen, there is a kind of valve which is formed by the attachment of the pillars to its walls. The mucous membrane lining the free surface of this canal is wrinkled; but that which forms its internal surface is white and folded longitudinally and resembles that of the œsophagus. Some conical papillæ are situated at its opening into the psalterium. The canal is controlled by the action of transverse and longitudinal muscular fibres. For example, we may point out that the longitudinal fibres, by drawing the tips of the pillars together, complete the formation of a channel leading from the œsophagus into the manyplies, thereby quite closing up the openings into the rumen and the reticulum. The third compartment is called the omasum, or psalterium, or manyplies. It is situated at the fore part of the right sac of the rumen. It is intermediate in point of size between the reticulum and the abomasum.

The food, after it has been remasticated, enters the third stomach. The leaves present herein absorb the excess of alkaline saliva, and so render the food drier for the abomasum. The leaves are covered with villi. A hard and thick epithelium

covers the leaves, and in fact all the first three stomachs are covered with hard epithelium. In the sheep and goat this compartment is smaller than the reticulum.

When the third compartment is full, it has an ovoid shape and is slightly curved and depressed from above downwards. Its anterior surface is attached to the diaphragm by means of cellular tissue, and the posterior surface is in relation with the rumen. The

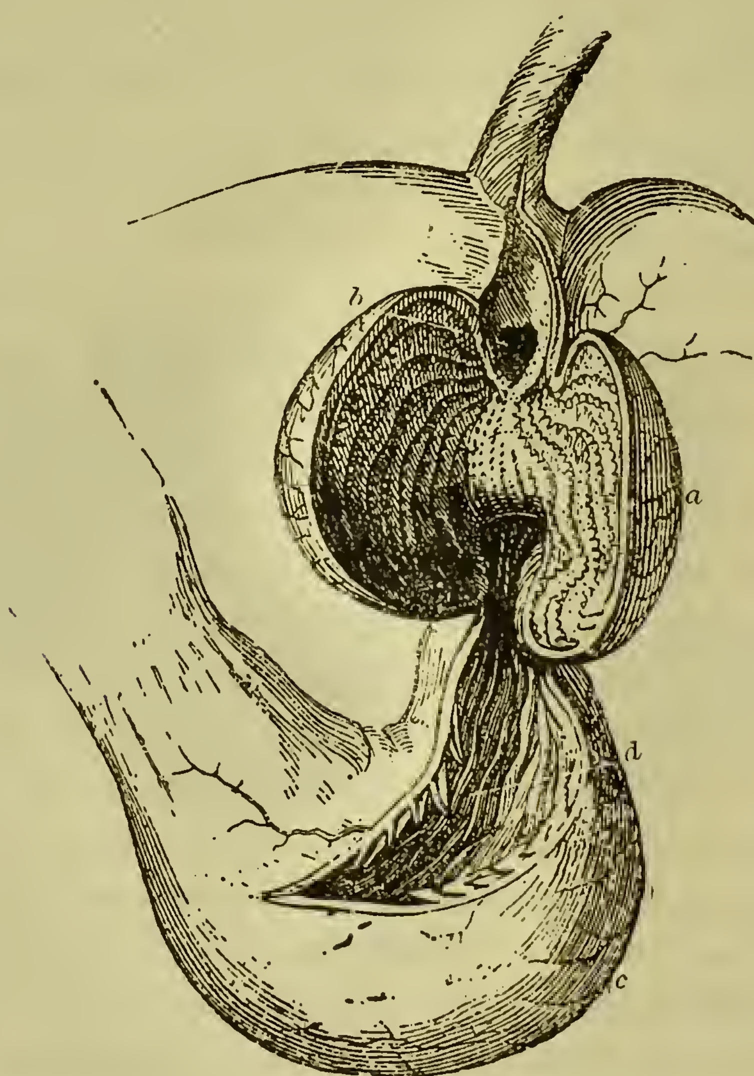


FIG. 9.

a. The Manyfold cut open; *b.* The opening communicating with the Honeycomb; *c.* The Abomasum, Rennet, or Reed, or true stomach; *d.* The Villous Membrane of the latter. (Simonds.)

greater or convex curvature is turned upwards, and it is attached by means of a fold of peritoneum to the posterior fissure of the liver. This fold of peritoneum is continued on to the lesser curvature of the fourth compartment, and thence to the duodenum. The lesser curvature has a downward direction and it comes into relation with the second stomach. The left extremity is thin and forms the neck which communicates with the reticulum. The right end is continuous with the base of the fourth compartment

from which it is separated by a slight constriction. The cavity of the omasum opens on the one side into the second, and on the other side into the fourth, compartment. In the interior are numerous leaves or folds of the mucous membrane. They are really lengthened elevations of the mucous membrane, each being formed of two layers of membrane lying against and rather close to each other. They are arranged transversely, and follow the long axis of the organ. They vary from 100 to 130 in number. They are not equal in size. By one border they are attached to the great curvature of the cavity. The other border is concave and free, and it is turned towards the lesser curvature. These folds resemble the leaves of a book, and they are provided with small hooks for catching the food which has escaped mastication. As we have said above, the cavity is ovoid in shape, and hence the central leaves are the longest and largest. Between each pair of large leaves intermediate and small leaves are placed, but these extend only a little distance. The leaves are formed of an inner framework of muscular fibres. This is covered on both sides with mucous membrane which is elevated to form papillæ. Some of these papillæ are large and bent, and retain portions of food which need to be more strongly triturated, while other papillæ are small. The fluid and finer particles of food pass on into the abomasum. At the entrance of the œsophageal canal the papillæ are large and hooked. The use of these papillæ may be to retain the alimentary material in the cavity, and for this purpose also the omasum has a small valve at the orifice which leads to the abomasum, or fourth stomach, which we now proceed to describe briefly.

The abomasum or rennet or reed is the true digestive stomach. In regard to capacity, the abomasum comes next in size after the rumen. It is situated behind and on the right side of the manyfold, and is especially large in the young animal. When removed and dried, the stomach in the calf is termed the rennet. It is used to coagulate milk in making cheese, for it contains the gastric glands, *i.e.* the glands which secrete the gastric juice, and this fluid acts on the caseine of milk and coagulates it. The mucous membrane lining this stomach is villous, velvety, soft, vascular, and of a reddish hue. The velvety or villous nature of the lining is caused by numerous tiny irregular pro-

jections arranged in longitudinal folds or ridges which disappear at the pyloric orifice, the entrance into the intestinal canal. Along these longitudinal folds the true digestive glands are arranged. They are embedded in the mucous membrane, and the function which they discharge is the secretion of the gastric juice. The abomasum is curved upon itself, and elongated from before backwards. It is continuous with the psalterium on the one side and opens into the duodenum on the other. This stomach, the abomasum, as we have said above, is alone to be regarded as the truly digestive stomach. The first three compartments are to be looked upon in great measure as being specialised dilatations of the œsophagus. The abomasum, on the other hand, is provided with peptic glands, and the secretion which it pours out has an acid reaction. The hard epithelium above-mentioned is not continued beyond the third stomach. The muscular coat of the abomasum is well developed, as also is that of the rumen.

The right side of the abomasum is situated in the epigastric region, and it comes into relation with the diaphragm, while its left side is in contiguity with the rumen. The greater curvature is turned backwards, and from it the great omentum hangs. The lesser curvature is directed upwards, and it is made fast by means of serous membrane to the greater curvature of the manyplies. The base of the abomasum is in contact with the cul-de-sac of the second compartment, and it is separated from the manyplies by a constriction. The opening into the duodenum is directed upwards and backwards, and it is called the pylorus, and around it the muscle forms a thick sphincter, by means of which the orifice can be closed or opened as occasion may require. The interior of this stomach resembles the villous portion of the stomach of a horse, and the mucous membrane is elevated in the form of oblique folds which extend in a spiral direction from end to end. The serous coat is a continuation of the great omentum. The muscular coat is similar to that of the horse's stomach, and the mucous coat containing the glands and follicles which secrete the gastric juice is covered by a thin layer of epithelium. Regarding the functions of each of the four stomachs, the rumen is the sac where the aliment ingested during feeding time is collected, and then, more or less softened, transferred to the mouth during rumination. The

honeycomb is especially to be regarded as a reservoir for liquids, the solid substances contained in it being always diluted by a large quantity of water. The œsophageal groove or gutter conveys into the manyfold the remasticated food swallowed a second time, or even in small amount that which the ox ingests for the first time (Chauveau). The manyfold completes the trituration of the food by compressing it between its folds. The abomasum is the true stomach in which gastric digestion is performed.

The stomach as above described may be said to be that of a typical ruminant, as it exists in the cavicornia, and in most deer.

The Camel's Stomach.—There are no villi in the rumen of the camel; the mucous membrane of that compartment being smooth. The rumen is, however, in this animal provided with large and deep cells, in which water is retained. The reticulum also has cells, as is usual, and it is very large, and appears to be the chief receptacle for pure water. It is to be borne in mind that food never passes from the rumen into the reticulum; but water can pass from the reticulum into the rumen. In fact, food may go from the œsophagus into the first, or the second, or the third stomach. It passes as a rule into the second, and only unusually into the first or the third compartment. After it has been re-masticated, it habitually goes into the psalterium. In the case of the camel, however, the psalterium is only very slightly developed, and is not provided with leaves. In the camel the abomasum is divided into two parts, a cardiac and a pyloric part.

In one group of the deer tribe, the Tragulidæ, the psalterium is represented merely by a short tube joining the reticulum and abomasum. In these animals, also, the œsophagus marks the line of demarcation betwixt the rumen and the reticulum.

The Intestinal Canal.—In regard to the small intestine of the ox, it may be said that it does not differ very markedly from that of the horse. It is smaller in calibre, but, as a rule, of double the length. The duodenum is expanded. The small intestine as a whole is very long, and there are many series of convolutions. Peyer's patches are larger than in the horse, but they are not so numerous.

The cæcum is not provided with longitudinal bands, and it is

devoid of transverse furrows at its extremity. It is simple, and oblong in shape, and there is a large patch of follicles in the recess of the cæcum. Its blind ending is blunt, rounded and directed backwards, and it lies freely in the abdominal cavity. The other extremity, having received the insertion of the ileum, is continuous with the colon, which is likewise destitute of bands and furrows. The colon soon becomes much narrower, and then, preserving about the same diameter for the rest of its extent, it is arranged in an irregularly elliptic coil situated between the folds of the mesentery. It is twisted spirally, and finally crosses over the duodenum. Thus we see there is no such distinct demarcation betwixt the great and floating colon as there is in the case of the horse.

Coming now to the large intestine, we find that its total length in the case of the ox, beginning from the cæcum and ending at the rectum, is about 36 feet; but its capacity is considerably less than that of the horse.

The Liver of the ox is very thick, and is situated in the right hypochondriac region. It has two large lobes, right and left, together with a small spigelian lobe and a small quadrate lobe situated supero-posteriorly. It is provided with a pear-shaped gall-bladder attached above, and lying upon its posterior surface. The gall-bladder has three coats—serous, muscular, and mucous—and it is continuous with the biliary ducts. The cystic duct extends from the gall-bladder almost to the transverse fissure, where it joins the hepatic duct. In the ox this latter duct enters the duodenum singly in advance of the pancreatic duct, being guarded at its orifice by a valve-like doubling of the mucous membrane. In the smaller ruminants there is a ductus communis choledochus.

The liver of the giraffe, like that of the camel, is small, flat, and light, and it weighs about 6 lbs. The spigelian lobe is small. In all ruminants the liver is confined to the right hypochondrium and the middle epigastric region, and in these animals it presents a slight split in the middle. In the whale, in which animal the body is in a large degree inflexible, the liver is, as is naturally to be expected, undivided. In human beings, likewise, the liver is slightly divided, for in them also, as compared with animals, there is but little movement of one part of the body upon another. On the other hand, the liver of the cat is very much

divided; but in ruminants this is by no means so markedly the case. In this connection it may be suggested that in carnivorous animals the liver has a great deal more work to do than it has in those which are herbivorous, and also that the ingestion of too large an amount of meat has a bad effect upon human beings, partly on account of the extra work which is thereby thrown upon the liver. With regard to the gall-bladder, it is to be remarked that the camel, the giraffe, the cervidæ, in common with the perissodactyle ungulata, have none, whereas all the cavicornia, together with the musk deer and tragulus, possess one.

Pancreas.—In all birds the pancreas is contained in a loop of the duodenum. The pancreas of a mammal is firm and lies transversely in the abdomen. Moreover, in birds the pancreas is redder than in mammals, and it is much less divided. In the ox the pancreatic duct enters the duodenum separately.

Spleen.—The spleen has the serous coat less firmly attached than is usual in mammals. It is uniform in thickness throughout its extent, save for its two rounded extremities. This organ adheres to the left side of the paunch and the diaphragm; but it is not supported by the great omentum.

The Lymphatics.—In the large ruminants the thoracic duct is very complex, very variable, and sometimes double throughout its extent. Some complexity is generally to be found near its anterior termination. It is more deeply seated than is the corresponding structure in the horse; and it lies between the right upper part of the aorta and the vertebral column, buried in fat. It passes through the diaphragm by itself, and not through the aortic aperture.

In the thorax the lymphatic trunk bifurcates, and the two trunks perforate the diaphragm. In the case of the ox it forms a large plexus. No movements, such as those of the lymph-hearts of frogs, are manifested; but there is contractile power at certain parts. The mesenteric glands are very numerous.

THE RESPIRATORY SYSTEM.

The nostrils of the ox are narrow, and, as compared with those of the horse, they are only capable of a slight degree of dilatation. There is an additional third turbinal bone. The frontal sinuses in the ox are continuous with the cavities in the horn cores,

and with those present in most of the bones of the cranium. The nasal chambers communicate at the posterior nares below the lower border of the vomer. Each contains a structure entitled the canal of Jacobson, which communicates with the mouth. These canals begin in the floor of the nasal chamber, one at either side of the septum. They run forwards, and come to an end behind the pad forming the front of the palate. These canals contain a number of mucous follicles.

The larynx is simple, the lateral ventricles and true vocal chords being only slightly developed.

The ox has the lower vocal chord more markedly developed than the upper, and bellowing is due to the length of the lower vocal chord. The giraffe has voice only during that season.

The trachea varies in length in different ruminants. For example, in the tragulus there are 50, and in the giraffe 100, tracheal rings. These rings are never perfect as they are in birds. A third bronchus is present. It passes to the right lung to supply a separate lobe which is not met with in the horse.

The thorax has a relatively small capacity in ruminants. In regard to the pleuræ it is to be remarked that the posterior mediastinum is strong and not perforated. It completely separates one pleural sac from the other. This arrangement occurs in all domesticated mammals with the exception of the solipedes. The left lung is divided into two lobes, the right into four, and the anterior lobe curves over and nearly covers the front of the heart. In the camel the left lung is only rarely divided.

The interlobular tissue is thick in ruminants, and hence the separation between the lobules is distinct. The knowledge of this arrangement renders intelligible the distribution of pneumonic lesions in the larger ruminants.

THE URINARY SYSTEM.

In some animals the kidney almost resembles a bunch of grapes, each lobule (grape) being provided with its own blood-vessels and excretory duct. This subdivision occurs in all animals in early fœtal life; but in most kinds of animals the outer parts of the lobules coalesce, and the organ becomes a single mass. The kidney of the ox is intermediate in form, the inner substance of the organ being united, while the outer sub-

stance is divided into lobes. The pelvis is the name given to the principal cavity, and there is a diverticulum or calyx for each

Fig. 10.

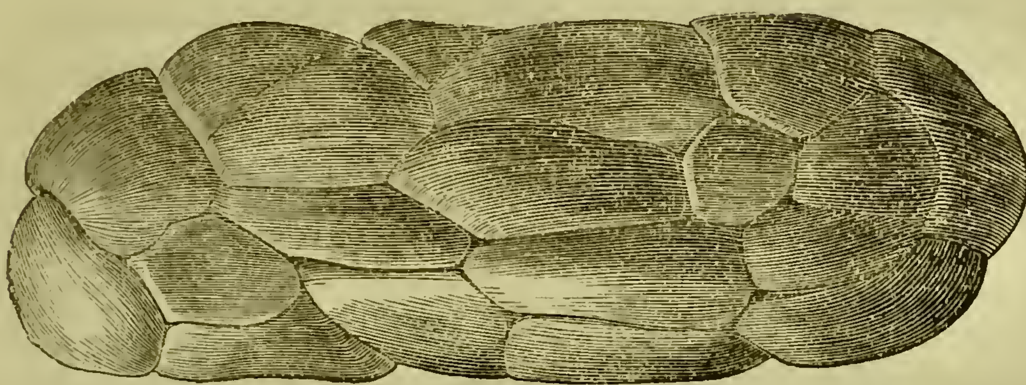


Fig. 11.

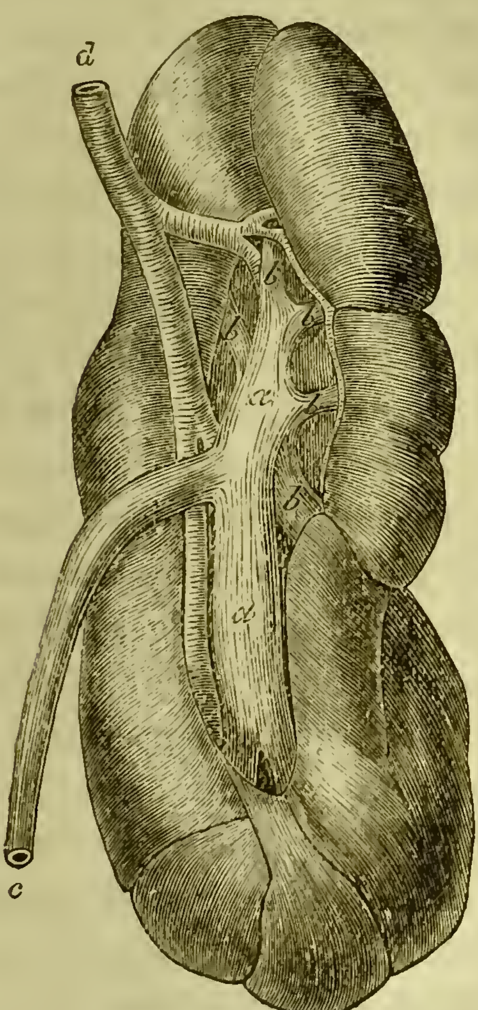


Fig. 12.

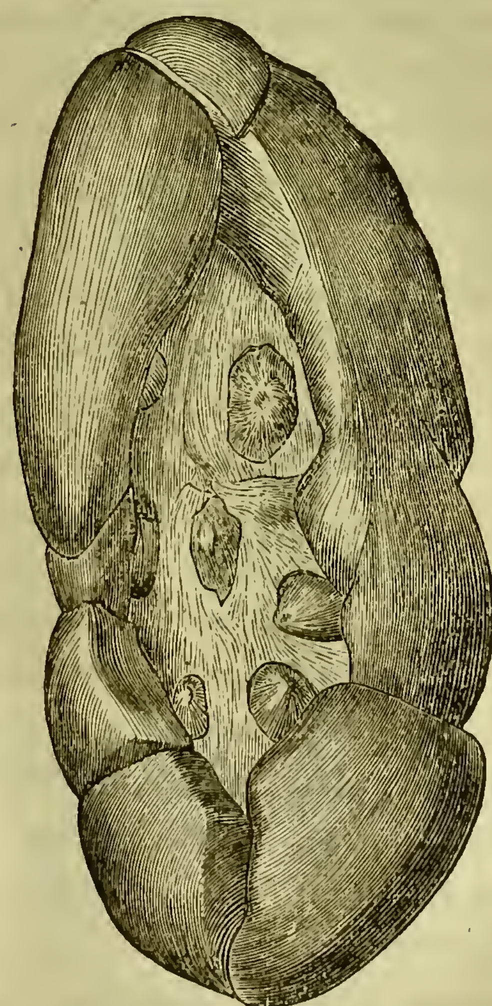


Fig. 10.—Right Kidney viewed on its Upper and External Face.

Fig. 11.—Left Kidney from its Internal and Inferior Face.—*a.* Pelvis; *b. b. b.* Branches of the Pelvis terminating in Calices; *c.* Ureter; *d.* Renal Artery.

Fig. 12.—The Calices in the Left Kidney.—The Contents of the Hilus, including the Branches of the Pelvis, have been removed to show the Tubercles at the bottom of these Calices. Only seven are visible, the others being beneath the borders of the Renal Fissure.

lobule, the uriniferous tubes of each calyx opening on a papilla. The kidney is ovoid and elongated. The smaller ruminants have a simple kidney, which is more like that of the horse than is that

of the larger ruminants. Tragulus and small ruminants have simple kidneys, there being no cones at all. In the camel and other large ruminants the cones are independent towards the cortex, and unite towards the centre and open on a ridge. In the bovidæ the cones are distinct throughout, and there is one separate papilla for each cone.

The bladder of the ox is larger than that of the horse, and its peritoneal covering extends further backwards.

GENERATIVE SYSTEM.

Male Organs.—Now, as regards the male organs of reproduction, all ruminants have the scrotum developed. They have no os penis as the carnivorous animals have. The prostatic glands are large in the case of the ox, and frequently special glands in connection with the reproductive system are developed in ruminants. For instance, the musk gland is a preputial gland. The testicle is ovoid and well developed, its long axis being nearly vertical. The mediastinum is very strong. The epididymis has a well-marked globus major. The globus minor gives off inferiorly a free projection, which doubles upon itself and leads to the vas deferens. The bulbous portion of the vas deferens joins its fellow at the neck of the bladder, forming thereby the common deferent canal, which opens by two orifices into the urethra. The vesiculæ seminales are large, lobulated, yellow in colour, and glandular in structure. They have been called the lateral prostates. They discharge their secretion into the common deferent canal. The urethra gradually diminishes in calibre from its origin. Just before the pubis it describes a double curve on itself like the letter S. The prostate gland is small, but it extends posteriorly under Wilson's muscle. Cowper's glands are present, according to Leyh, although they are very small. The penis of a ruminant is long and thin, and extends a long way under the abdomen. It is bent upon itself in the form of the letter S, a little in front of the bulb, the inferior curvature being forwards, and the superior backwards. About this level the suspensory ligaments join the penis, and extend to its extremity. The glans is small and attenuated, the canal of the urethra ending in front in a narrow whip-like process of the corpus spongiosum, which is covered by a rosy, papillated, and sensitive integument. The sheath extends much farther forwards than in

the horse, and it presents at its opening a number of long stiff hairs, the prepuce being prolonged as an elastic sheath. It is furnished with four thin muscles, two anterior and two posterior. The anterior are protractors, and restore the prepuce to its normal position. The posterior are retractors, and draw the sheath backwards during the erection of the penis. During erection the curves in the penis are not shown, but when it is quiescent and drawn into the sheath by the retractor muscles, the curvatures are re-formed. The urethra is the mucous canal inside the corpus spongiosum.

Female Organs.—The ovaries are rather small. The cornua of the uterus are slightly twisted, and the ligaments are large. The fundus is short and narrow. The mucous membrane of the uterus presents a number of rounded vascular processes, which exhibit eminences and depressions. These processes are the maternal cotyledons. During gestation there may be seen in each of the lateral walls of the vagina a mucous canal which opens into the vulva on either side of the meatus urinarius. These are the canals of Gärtner. They are not present in the smaller ruminants.

The labia of the vulva are thick, and its inferior commissure is narrow and furnished with a few hairs. Inside the vulva are the vulvo-vaginal glands, and there is a small blind cavity, or diverticulum in the wall of the urethra, covered by a fold of mucous membrane.

The udder is composed of two symmetrical halves mesially connected together. Each half is again divided into two distinct glands, each provided with its own teat, and hence the udder is composed of four separate mammæ. Behind these four teats there may be two small rudimentary teats. In the centre of each quarter, just at the base of the teat, is a large galactopherous sinus, the general receptacle of the milk. From this sinus, which is sometimes large enough to contain a quart, one excretory canal proceeds down the centre of the teat.

With regard to the uterus, the horns are very long and large, and it may be remarked that length of the cornua indicates lowness of development. In its original condition the uterus was doubtless bifid. The cornua are larger in the goat and sheep than in bovidæ and cervidæ. The chorion usually has villi, and the cotyledons are simply patches of villi. Some

ungulates have diffuse and some have cotyledonous placenta. The giraffe has a transitional form of placenta, namely—patches with occasionally a few villi. Hence in the tragulus and camel the placentation is diffuse, in the giraffe it is of an intermediate kind, and in other ruminants it is cotyledonous. In having a diffuse placentation the tragulus and the camel are like the mare and the sow. All ruminants are non-deciduate, and in this point they agree with all cetacea.

EMBRYOLOGY.—*Ox.*—At twenty-eight days the embryo has a length of $\frac{2}{5}$ inch, and corresponds in its development to the sheep's embryo of twenty-five days.

Sheep.—The embryo of the sheep at eighteen days has a length of $\frac{1}{3}$ inch. At twenty-three days signs of the feet appear. After twenty-five days it has a length of $\frac{2}{5}$ inch, and indications of the eyes, ears, and tail are present. The intestine exists as a tube connected with the umbilical vesicle. The Wolffian body is well developed.

The giraffe is the only animal which is born with horns. The embryonic period of the giraffe is 444 days. That of the sheep is only nine months.

THE CIRCULATORY SYSTEM.

The blood-corpuscles of ruminants differ from those of other animals in being rather small. In camels the corpuscles are elliptic, and some are round. In the llama the round cells are more numerous, but not so numerous as the elliptic cells. In the giraffe they are about $\frac{1}{4500}$ inch in diameter, in tragulus $\frac{1}{12800}$ inch, and in man about $\frac{1}{3200}$ inch. The heart is conical in ruminants. There are bony developments in the heart of the ox, in that of the red deer, and that of the giraffe, at the point of union of each auricle with the corresponding ventricle. They constitute the most prominent characteristic feature of the heart in ruminants. They appear in adult life, are two in number, and lie between the auriculo-ventricular rings and the common aorta on the left and the pulmonary artery on the right side. The mitral valves are not so separate as the tricuspid.

The moderator band, a muscular development, occurs in the right ventricle in ruminants as well as in some other animals, *e.g.* the ostrich. There are retia mirabilia in the cranium, and large sinuses run round the base of the sella turcica. Creatures like

the ox have these plexuses most largely developed. In the giraffe there is scarcely a trace of the plexus, and in this connection it should be said that this animal eats with its head

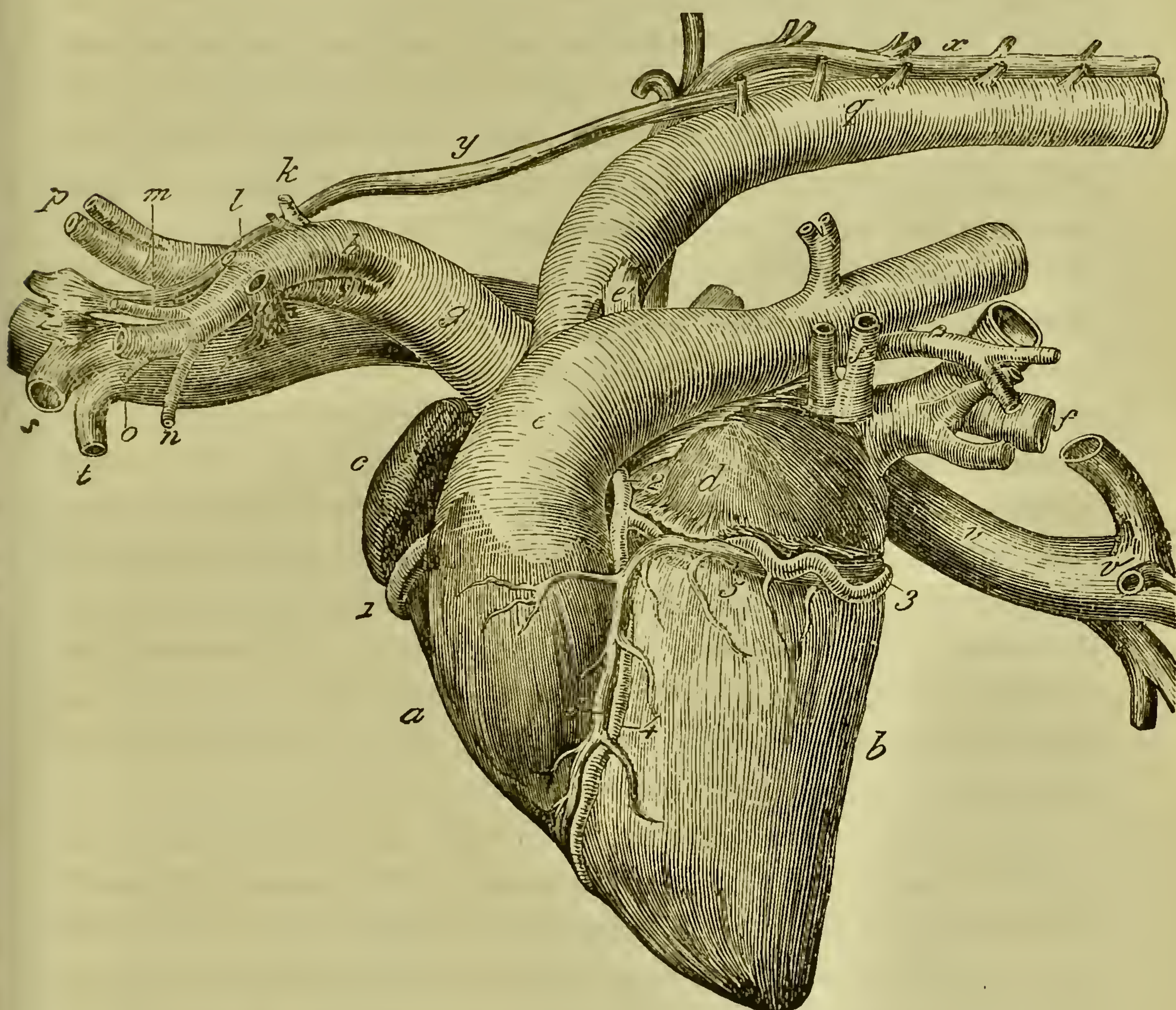


FIG. 13.—THE HEART AND PRINCIPAL VESSELS, LEFT FACE.

a. Right ventricle; *b.* Left ventricle; *c.* Right auricle; *d.* Left auricle; *e.* Pulmonary artery; *e'.* Obliterated arterial canal; *f.* Pulmonary veins; *g.* Anterior aorta; *h.* Left axillary artery; *i.* Right axillary artery, or brachiocephalic trunk; *j.* Origin of the dorsal artery; *k.* Origin of the superior cervical artery; *l.* Origin of the vertebral artery; *m.* Origin of the inferior cervical artery; *n.* Origin of the internal thoracic artery; *o.* Origin of the external thoracic artery; *p.* Carotid arteries; *q.* Posterior aorta; *r.* Anterior vena cava; *s.* Trunk of the axillary vein; *t.* Trunk of the internal thoracic vein; *u.* Trunk of the dorso-cervical vein; *v.* Posterior vena cava; *v'.* Embouchure of the hepatic and diaphragmatic veins; *x.* Vena azygos; *y.* Thoracic duct; *z.* Embouchure of that vessel, placed near the origin of the anterior vena cava. 1. Right cardiac artery; 2. Left cardiac artery; 3. Auriculo-ventricular branch of the left cardiac artery; 4. Its ventricular branch; 5. Cardiac vein.

high up in the air, whereas most ruminants graze with their heads near the ground. There is no definite bifurcation of the carotid arteries in ruminants.

There is a third longitudinal furrow running down the wall

of the left ventricle posteriorly. There are usually nine aortic intercostals, and three anterior ones, *i.e.* twelve in all. The cæliac axis reaches the rumen just behind the œsophagus. On the left the artery of the reticulum is given off. It passes to the left of the œsophagus, and divides into a superior and an inferior branch. The splenic artery arises just behind this. Still farther back arises the hepatic artery. It supplies the liver and gall-bladder, and gives off the duodenal branch, which anastomoses with the superior artery of the abomasum, and the anterior mesenteric artery. The terminal branch of the cæliac axis divides and forms the superior and inferior arteries of the psalterium and abomasum. These pass along the surfaces of these two stomachs, the superior artery anastomosing with the duodenal artery.

The superior and inferior arteries of the rumen run in the longitudinal groove. The former usually arises from the splenic artery, running backwards. The latter is generally given off by the artery of the reticulum. It runs forwards and between the anterior sacs to gain the inferior surface, where it passes backwards and reaches the grooves between the conical sacs, anastomosing with the superior artery.

The anterior mesenteric artery divides into two branches, an anterior branch for the small intestine, and a posterior branch for the large intestine. The former resembles that of the horse in its distribution. The latter, instead of following the flexures of the colon, gives off branches which cross them. The posterior mesenteric artery is small. The middle sacral artery is very large and gives off the arteries of the tail. It may be looked upon as the continuation of the posterior aorta. The lateral sacral arteries are somewhat rudimentary. In the smaller ruminants the obturator and iliaco-femoral arteries are absent, and are replaced by branches from the deep femoral artery. In the ox these arteries are rudimentary. The uterine artery is very large, and it arises from a trunk which also gives rise to the umbilical artery.

Of the arteries of the hind limb, the great metatarsal artery, accompanied by two veins, occupies the mesian groove on the front of the metatarsus, passes through the notch between the distal articular surfaces, and gains the back of the digit, where it is called the common digital artery. Above the distal ends of the ossa suffraginis it divides into external and internal ungual

arteries, each of which gains the inner aspect of its respective digits, and enters the distal phalanx. The lateral digital arteries pass down the outer sides of the digits, that of the external digit being formed by the interosseous plantar and a transverse communicating branch, while that of the internal digit is given off by the great metatarsal artery.

The anterior aorta may be either very short or absent. In case it is wanting, the brachials arise from the common aorta. The dorsal and vertebral arteries arise from a common trunk. The former gives off a branch which takes the place of the superior cervical artery. The vertebral artery is large and does not inosculate with the occipital, but ends in muscular branches. The humeral artery is small, as also are most of its branches. The chief artery supplying the muscles of the posterior brachial region is the scapulo-humeral branch of the subscapular artery. The radio-palmar artery forms an inferior arch (as is also the case in the horse), from which are given off three interosseous palmar arteries (of which the internal is the largest and most constantly present), and one dorsal or anterior interosseous artery which comes to the front of the limb, anastomosing above with the anterior radial artery, while below it occupies the vertical groove in the metacarpus, and inosculates with a recurrent branch of the great metacarpal artery passing between the articulations at the distal end of the bone. The arteries of the digit resemble in the main those in the hind limb.

The carotid arteries arise, as in the horse, by a trunk from the brachio-cephalic artery. At the head they form the external carotid artery and the occipital artery, which is small. The carotid arteries in ruminants do not definitely bifurcate, the function of the internal carotid artery being performed by the encephalic artery. The occipital artery enters the cranium by the condyloid foramen, passes backwards and inosculates with the lateral artery of the spinal cord at about the level of the internal foramen of the atlas. A branch given off from this union passes out through the foramen to supply the muscles of the poll. The lingual artery gives off the sub-lingual artery, and is itself a branch of the external carotid artery. The mastoid artery of the horse is represented in the ox by a branch of the posterior auricular artery. In the case of the smaller ruminants the coronary arteries of the lips are formed by the

bifurcation of the transverse facial, a branch of the superficial temporal artery. The internal maxillary artery has no pterygoid foramen to pass through in any domesticated ruminant. The largest of the arterial plexuses or retia mirabilia inside the cranium are formed by branches from the internal maxillary artery. One of these branches, the spheno-spinal, enters the cranium by the foramen ovale, and, as a rule, two arteries to the rete enter by the anterior common foramen. The first of these inclines forwards, the two latter backwards. The three arteries anastomose by forming a small and intricate plexus known as the cranial rete mirabile. It is situated at the side of the sella turcica of the sphenoid bone, communicating with its fellow posteriorly, and giving off superiorly the *encephalic artery*, a branch considered by Chauveau to be analogous to the intracranial portion of the internal carotid in the solipede.

From this artery are given off the cerebral arteries—anterior, middle, and posterior. The last passes backwards, and forms a convergent anastomosis with its fellow, thus constituting the basilar trunk which leads to the middle spinal artery. Another arterial plexus is formed on the ophthalmic artery just where the arteries of the eye are given off. The glosso-facial artery is present only in the larger ruminants.

VEINS.—The subcutaneous abdominal vein is very large in the ox, the subcutaneous thoracic vein being small in proportion. The saphenous veins differ from those of the horse, the external saphenous vein being larger than the internal one.

The valves in the veins are well developed. Each vena azygos of the two so-called may persist. In some antelopes the left vena azygos is larger than the right azygos vein. In ruminants the portal veins have valves, and in these animals there is provision made for the blood making its way by two openings, one at the base of the temporal, the other, as in the case of human beings, through the foramen lacerum posterius. There is one anterior vena cava.

The jugular vein is large, and there is a small accessory jugular vein which varies much in size, originating in the occipital vein and joining the great jugular vein near its termination. The angular vein of the eye is very prominent in small ruminants. There are three digital veins of the hind limb, including an anterior or common one between the digits, formed by twigs from the

solar plexuses of both, and two lateral ones placed on the two sides of the digits. There are usually five metatarsal veins, two anterior deep ones which accompany the great metatarsal artery, an anterior superficial one forming one root of the external saphenous vein, also an internal and an external posterior vein. These two last-mentioned veins pass upwards over the tarsus and assist in forming the saphenous veins. In the anterior limb there is a fourth or posterior digital vein, which accompanies the common digital and internal metacarpal arteries.

NERVOUS SYSTEM.

In the giraffe the cervical region of the spinal cord is very long owing to the great length of the neck. In the porpoise this part of the cord is the shortest. Tragulus has the spinal cord small, the animal itself being small. The echidna, hedgehog, and some bats have the spinal cord not proportionate to the weight of the body. The lateral lobes of the cerebellum are small in tragulus, and the pons also is very small. In the giraffe it is large. The central lobe is asymmetrically contorted in the horse, and also in the rhinoceros, and also in the giraffe.

The corpora quadrigemina (*Mesencephalon*) are relatively large. This is a mark of low development. The posterior lobes of the corpora quadrigemina are larger than the anterior, whereas in carnivorous animals the anterior are the larger. In tragulus the convolutions are simple. In larger ruminants the convolutions are more numerous, and in the ox they are most numerous. In all ungulates the convolutions pass from behind forwards and inwards. The sylvian and the supra-sylvian fissures are very indistinct and ill-marked. These two fissures are less neatly and less clearly marked than in the case of the carnivora. The sylvian and supra-sylvian fissures are most markedly developed in the proboscidea and cetacea, next in ruminantia, next in carnivora.

The olfactory region in ruminants is large. The horse, having large eyes, has consequently large posterior corpora quadrigemina. The optic nerve in ruminants is large, but the thalami optici are not large. The retractor bulbi muscle is supplied by the sixth pair of nerves. The fifth pair of cranial nerves is large in ruminants, and it supplies the horns and the sensitive region in connection with them.

The spinal cord of the ox is not prolonged further backwards than in the case of the horse.

As compared with the horse, the optic nerves and pituitary glands are large, and the testes are more separated from the nates than is the case in that animal. The cerebral convolutions are fewer but larger, and the hemispheres are larger posteriorly. The jugular ganglion and the pharyngeal branch of the tenth nerve are both very large. The recurrent nerves are separated from the trunk of the vagus and the carotid artery by the œsophagus, and the latter is more amply supplied with nerves than is the gullet of the horse. The superior œsophageal branch chiefly supplies the rumen, while the inferior œsophageal branch is distributed to the other compartments of the stomach. The spinal accessory nerve divides into two branches, superior and inferior, the latter supplying the muscles of the lower portion of the lateral cervical region.

The radial nerve gives off two cutaneous branches which pass downwards. One of these terminates at the carpus, while the other, becoming more anterior, descends upon the metacarpus and supplies the dorsal nerves of the digits. The median and cubital nerves are not connected at the carpus, but continued downwards, the former as the internal, the latter as the external, metacarpal nerve, each supplying its respective digit. Near the distal end of the metacarpus a branch from the internal metacarpal nerve passes across to join the external metacarpal nerve, while lower down a second branch from the internal nerve forms the external collateral nerve of the inner digit, and still lower a third branch from the same source forms the internal collateral nerve common to both the digits. In the nerves of the lumbo-sacral plexus it is noticeable that the dorsal nerves of the digits are given off by the musculo-cutaneous nerve. From the anterior tibial nerve a branch passes down the anterior groove in the metatarsus. It divides in the digital notch to form the posterior deep digital nerves. There is no branch connecting the external and internal metatarsal nerves.

THE EAR, EYE, HAIR, HORNS, AND HOOFS.

The concha of the ear of Ruminants is widely open, projects outwards, and is less mobile than that of the horse. The handle of the malleus is more curved than in the horse.

The tapetum lucidum of the eye is of a golden green colour, inclining to blue at the circumference. The "gland of Harder" is present in all the domesticated animals. The eye of the ruminant is in most respects similar to that of the solipede.

The *hair* on the tail of the ox, as in the ass, is long only at the end, where it forms a tuft. Between the horns, the hair is thick and curly, but these qualities vary in degree with the breed. The wool found on some of the smaller ruminants is a kind of hair.

The *horns* consist of a layer of horn tissue which has been developed by the vascular and nervous membrane which covers the horn-core, forming at its base a circular pad, continuous with the dermis. Both the membrane and the pad produce horn-tissue, and hence the tissue of horns, in like manner with the wall of a horse's hoof, is derived from two sources. The portion of the horn surrounding the pad is known as the *root*, that covering the core the *body*, while the part projecting beyond the core is the *point*. The horn presents a number of rings just above its root. Horns vary greatly in shape. In the bovidæ the typical form is crescentic, the convexity being turned more or less downwards and outwards. In the ovidæ the horns are, as a rule, curved spirally, and sometimes very gracefully curled, the first bend being convex outwards and forwards. In the goat they are closer together, and more perpendicular, being slightly curved with the convexity inwards. Camels are devoid of horns, whereas other ruminants have horns of large size. Animals possessing horns of the above type are called cavicornia, or hollow-horned animals. The horns of deer differ in being formed of solid bone, in having branches, and in falling off every year, to be replaced by new ones. The *hoof* is divided into two parts, one for each digit, each part resembling in shape the distal phalanx. Their general structure resembles that of the horse's hoof, but the frog is little developed. A small horny projection appears on each side of the posterior aspect of the fetlock. These are rudimentary hoofs, each containing a small bone not connected with the skeleton.

CHAPTER III.

DIFFERENT BREEDS OF OXEN.

Before we commence to describe briefly the various kinds of oxen met with in England, we must first point out that they have been crossed to a very considerable extent. It is, moreover, a matter of great difficulty to decide which variety of the numerous kinds of cattle now existing in Great Britain is to be looked upon as most nearly resembling what we may consider the original British breed to have been. Whether the middlehorns or the longhorns are to be so regarded, it is next to impossible to decide positively. As for the shorthorns, they are evidently of foreign extraction, and polled cattle, although they have existed in certain districts for as long a time as the residents can remember, are, nevertheless, in all probability to be considered as examples of variation. On the whole, however, the evidence at our disposal seems to show that the middlehorns constitute the original British breed, and that the longhorned cattle came in the first instance from Ireland.

Now, it is clear that when the ancient inhabitants of Great Britain were at various times repulsed and driven before the invading foe they carried away their cattle to their strongholds in North Devon and Cornwall, or to the more mountainous districts of Wales, or even to the wealds of East Sussex; and the primitive breed of British cattle was thus preserved. Differences in the characters of the climate and the soil by degrees necessarily brought about certain corresponding changes of bulk and qualities in the cattle of different districts. The rich pastures of Sussex, for example, led to the fattening of the oxen of that district to such a marked extent as ultimately to lead to their superior size. Again, the herbage occurring in the northern

part of Devon, plentiful indeed, although not so luxuriant as that of Sussex, gave rise to the production of a smaller and more active animal; and the occasional privations met with in Wales brought about a lessening of bulk and the development of a thicker hide.

In turning our attention now to Scotland, we find that the ancient inhabitants of that country were at times repulsed and obliged to take refuge in their mountain fastnesses, wherefrom they could make an effectual stand against their pursuers. Hence it came about that their cattle, of which they were proud, were preserved in a state of purity.

Judging, then, from the above considerations, we see how it has happened that in Devon, Sussex, Wales, and Scotland the cattle have always been the same, whereas in all the eastern parts of England more especially, and indeed in almost every part of England, the cattle now met with have lost their primitive characteristics. Oxen emanating from neighbouring, and even in not a few cases those coming from remoter, districts, were crossed in all kinds of ways, and they also became gradually modified in correspondence with the characters of the climate and the soil. These original cattle, still found in Devonshire, Sussex, Wales, and Scotland, are possessed of horns of medium size, they supply a fair amount of milk—which, however, is noted rather for its quality than for its quantity—are active workers, and possess a special aptitude for fattening. Of course, they vary in accordance with the soil, the climate, and so forth. The cattle of Devon, Sussex, and Hereford are red in colour, and in this connection it is a very noteworthy fact that in almost every part of Scotland, as also in some of the mountainous districts of Wales, the milk of a red cow is supposed to act as a remedy for every disease and every sort of evil. The Devon cattle resemble the wild breed of Chatelherault Park, or those of Chillingham Castle, although the colour is not the same.

With reference to the size of oxen, the numerous varieties differ in a marked degree—so much so, in fact, that even adult animals of the Shetland breed are not much larger than the calves of some other kinds. Some of the cattle found in the torrid zone are likewise very diminutive; but, perhaps, the fatty hump found on the backs of the animals referred to may be

owing to a relationship betwixt them and the Indian ox or zebu, which animal is probably one of a species distinct from the common ox.

THE MIDDLE-HORNED CATTLE.

We now come to a brief consideration of the middlehorns, under which designation we include the cattle of North Devon, Cornwall, Dorsetshire, Somersetshire, Herefordshire, Gloucestershire, East Sussex, Kent, and most of the cattle of Wales. These oxen, known as the middlehorns, constitute a distinct, valuable, and very fine group. The cattle found on the Scottish and the Welsh mountains are small, and exhibit different characteristics.

The cattle of North Devon have for a long period of time been remarkable for their beauty, activity in work, and capability of being readily fattened. They are rather large, very muscular and powerful, very gentle and docile, and so well adapted for draught that much agricultural labour is even still carried out by teams of these animals in Devonshire. From the earliest times the breed has remained the same, or, at any rate, has not altered in any essential point until within the last thirty years or thereabouts. Indeed, the farmers of the county did not know until about the close of the last century that they possessed a breed of cattle superior to other varieties. In fact, it is only within the last fifty years that any efforts have been systematically made to improve the cattle in any part of the kingdom. The splendid specimens of the native English ox found in Devonshire are no doubt partly due to the influence of the soil and climate. These oxen of North Devon have been greatly improved, and, in all probability, if they were now crossed with any other breed disadvantage would result from such crossing. The following characteristics of the more perfect North Devon oxen may be mentioned. The horns should not be very thick at the root, and they should taper towards the tips. Their colour, too, should be yellow or wax-like, especially at the tips. The horns of the bulls are a little shorter, larger, and thicker, and of a darker colour. The eyes should be clear, bright, and very prominent, and the countenance should be animated. The eye ought to show a great deal of its white part, and it should have a circle of a dark orange or other colour sur-

rounding it. The forehead ought to be flat, small, and indented. The purity of the breed is in a great measure determined by the smallness of the forehead. The cheek should be small, the muzzle fine, and the nose of a clear yellow colour. The muzzle ought not to be black, nor even mottled. The nostril should be high and open ; and the hair about the head should be curly, though this may impart some coarseness of general appearance. The neck should be thick. As a rule the bulls of this breed are smaller than the cows, though otherwise the males are very similar to the females except in the region of the head and neck. The head of the ox is singularly small in relation to the bulk of the animal, and yet it has a remarkably broad forehead. The neck is long and thin, and well suited for the collar and even for the yoke. It is usually looked upon as a characteristic of good cattle that the line of the neck, from the horns to the withers, should scarcely deviate from that of the back. However, the Devonshire ox has a peculiar rising of the forehand, reminding us of the bloodhorse, and essentially connected with the swift action for which this breed is distinguished. This ox has little or no dewlap depending from its neck. The animal is light in the withers, the shoulders are a little oblique, the breast is deep, the bosom open and wide. The fore-legs are wide apart, and look like pillars constructed to support a great weight. The point of the shoulder is rarely or never seen. Angular bony projections are not observed in a beast which carries much flesh and fat. The fineness of the withers, the slanting direction of the shoulder, and the broad and open breast imply the possession of strength and the capacity for speed and for fattening. An animal which has a narrow chest cannot be useful either for working or for grazing. The legs of the Devonshire ox seem to be well under the chest, or rather, we may say, the breast projects far and wide beyond the legs. The legs are straight, or at least those of the best-bred animals are. If they are in-kneed or crooked in the fore-legs, they will be unsuitable both for work and for grazing, for they will be hollow behind the withers; and for this defect nothing can compensate, because it takes away so much from the place where good flesh and fat should be thickly laid on, and, moreover, implies a reduced capacity of the chest and consequently a want of power of producing good arterial blood. The fore-arm is very large and

powerful, it swells out suddenly above the knee, but is soon lost in the substance of the shoulder. Below the knee the bone is very small and apparently, but only apparently, weak, for the smallness is only in front. The leg is deep, and the sinews stand out far from the bone. The leg may seem to be a little too long, but this is all the better for a working ox. There is a very slight fall behind the withers, but no hollowness, and the line of the back is straight along its whole length to the point where the tail begins. The sides of the animal may appear to be a little too flat; but this flatness does not seem to interfere with the feeding, while a deep, though somewhat flat, chest is best adapted for speed. Not only, however, is the breast broad and the chest deep; but the two last ribs are very bold and prominent, thus leaving room for the stomachs and other parts concerned in digestion to be fully developed. The hips are high and on a level with the back, no matter whether the beast be fat or lean. The hind-quarters, occupying the space from the hip to the point of the rump, are very long and well filled up. Hence room is left for the deposition of flesh in the most valuable part; and, moreover, like the extensive quarters of the blood-horse, they point to the possession of great power behind. The fulness here and the swelling of the thigh below are of much greater importance than is the prominence of fat on the rump, which is so much admired in the case of prize cattle. The tail is on a level with the back, rarely elevated, and never depressed. The skin of the Devonshire ox is very mellow and elastic, although the curliness of the hair might at first sight seem to point to the possession of a less elastic skin. When the skin can be easily raised from the hips, we know that there is room for fat below it. The skin, too, is rather thin. The hair is curly, as we pointed out above, and these curls look like little ripples produced by wind on a smooth surface of water. Some of these cattle, however, have the hair smooth, and, if so, it should be fine and glossy. Those oxen which possess curly hair are said to be a little hardier than others not possessed of curly hair, and to fatten more readily. The colour is blood red, and this is supposed to indicate purity of breed; but many good specimens may be of a chestnut or even of a bay-brown hue. If the eye be clear and good and the skin mellow, it does not matter if the colour is paler than blood-red. If patches of white run, so

to say, into the red, the beasts probably come of a valueless breed. One of the most remarkable points about the Devonshire cattle is the comparative smallness of the cow. The bull is a great deal less than the ox, and the cow is as much smaller than the bull. The cows, however, although small, have the two or three last ribs so well-rounded and projecting as to make them roomy. The cow has a full, round, and clear eye, a gold-coloured circle round the eye, and the same colour prevailing on the inside skin of the ear. The countenance is animated, the muzzle orange or yellow, and the rest of the face has neither black nor white about it. The jaws are not thick, and the throat has no dewlap. The back and hind-quarters are round and beautifully made, and they are free from most of those angles by which good milkers are sometimes characterised.

These oxen of Devonshire are very useful for ploughing land, provided that it be not too heavy, for they are stout, quick, and docile. In the case of fallow land, four steers will in one day plough two acres by means of a double-furrow plough. At the same time we must remember that these oxen are not of sufficient strength to allow of their being used for ploughing tenacious and clayey soils. They are worked in yokes, not in collars; and four oxen, or perhaps six growing steers, are, as a rule, employed to draw one plough. As Mr. William Youatt has charmingly narrated in his book on cattle, a man and a boy attend each team. The boy chants a pleasing succession of sounds, and it is a very pleasant thing to listen to the simple music sung by the drivers of the ploughs as they slowly wend their way up and down the sloping hills which wall in the valleys. This chanting is said to animate the oxen, just as the musical bells, which are so prevalent in the county, likewise cheer. At any rate, it is certainly the case that the oxen move along with agility, and so willing are they in their work that we may watch the teams for a long time without either hearing any harsh word uttered by the drivers or seeing the whip or the goad being used. In this connection we may point out that the activity of these oxen is of quite an exceptional kind, and that it is entirely unknown in the case of the cattle of any other part of the kingdom. During the time of harvest, these oxen are sometimes trotted along with the empty wagons at even the rate of six miles an hour.

Lord Somerville states that, after having been worked lightly

on the hills for two years, they are bought, when about four years of age, by the tillage-farmer of the vales, and take to hard work when they are from four to six years old. An ox must be thus worked in order to attain his full size. At six he reaches his full stature, but may continue to grow for another half-year. The oxen of North Devon, although rarely shod, are very seldom lame. These Devonshire oxen do not, indeed, attain to the great weight of some breeds; but they acquire more flesh in a given time and with less consumption of food, and their flesh is of a beautiful mottled or marbled character, and is at once very pleasing to the eye and rich to the taste.

The milk of the Devonshire cows is good, and yields more than an average proportion of cream and butter; but it is deficient in point of quantity. However, according to Mr. Conyers, of Copt. Hall, near Epping, ten cows gave an average of five dozen pounds of butter per week in the summer, and of two dozen pounds in the winter, while a good North Devon cow fattened two calves a year. "My thirty North Devon cows," he said, "have this year [about 1788] upon an average produced a profit of £13 14s. per cow." According to Mr. Rogers, two breeders attempted to cross the North Devons with the Herefords, but without success. This same veterinary surgeon held the opinion, which no doubt is the correct one, that many maladies of cattle are due to injudicious exposure to cold and wet, and that to the height and thickness of the Devonshire fences the exemption from disease on the part of the cattle of that county is in some measure due.

Mr. Carpenter says that "one cross of the North Devon with the Hereford is advantageous, as thereby additional size and aptitude to fatten is gained without loss of activity." The single introduction of a Hereford bull of the very best blood may be tried; but Hereford heifers should never be crossed with Devonshire bulls. After the first cross as aforesaid with one Hereford bull, the best Devon bull should be again used, until the white face is almost entirely extinct, when for a second time a Hereford bull may be used.

The great secret about breeding successfully is to suit the breed to the soil and climate. Breeds which have been very valuable indeed in certain districts have proved entirely profitless in others. The South Devons are equally profitable for the

grazier, the breeder, and the butcher ; but their flesh is not so delicate as that of the North Devons, and it will not suit the fastidious appetites of the inhabitants of Bath and of the metropolis. A South Devon cow has been known, soon after calving, to yield more than two pounds of butter per day, and many of the old southern native breed are equal to any shorthorns in regard to the quantity of their milk, which, moreover, is of greatly superior quality.

Of the Cornwall cattle we shall not need to speak here, nor shall we do more than mention those of Dorsetshire and those of Somersetshire.

Hence we come next to discuss the characteristics of the cattle found in Herefordshire.

In the western parts of England as a whole a great variety of breeds are cultivated both for milking and grazing, and of these different breeds the chief are the Devons, which we have just described. Next come the Herefords, which we now proceed to describe. The cattle belonging to the Hereford breed are stouter than those of the Ayrshire variety; but in some respects they are more or less similar to them. Both the beef and the milk are very good. Nevertheless, we find that in the districts in which these animals formerly abounded oxen of the shorthorn breed have now in great measure supplanted them. The Herefords are noble creatures, and in point of feeding powers they are surpassed only by the shorthorns. Much of the richest pasture land in England is stocked with the pure-bred Herefords. They grow to a large size, and they usually take about a year and a half longer to arrive at their full degree of development than do the shorthorns. Up to quite recent times they have been, and sometimes, though very rarely, even now in these days they still are, employed in drawing the plough, not being sold off to be fattened until they are six or seven years old. Oxen of so great an age as this, are now but very rarely met with, and they are sought after by the graziers who reside in the rich midland districts on account of their capability of being readily fattened for the Christmas meat market. The Hereford cows are faulty in respect of the supply of milk, being, in fact, even worse than the shorthorns are for dairy purposes. In Herefordshire, their native county, the former cows are principally used for the rearing of the calves. The

Hereford of this present day is a much better animal than was its progenitor of some thirty years ago. Moreover, these animals are not capable even now of readily adapting themselves to the diverse characteristics of different climates as the shorthorns are. The Hereford oxen have white faces. With the exception of a few Alderney and Durham cows, they alone are found in the county. They are much larger than the oxen of North Devon. As a rule, too, they are of a darker red colour. Some of them are brown, some even yellow, and a few are brindled. Their faces, throats, bellies, the lower part of the legs, and the tip of the tail are white, and in a few the white colouring extends as far as the shoulders. The body, however, as we have implied, is of a rich red hue. On the other hand, the old Herefords were brown or reddish-brown, and not white in any part of the body. The modern breed is certainly greatly superior to the old one. The hide of a Hereford ox is much thicker than that of the Devon oxen, and the beasts themselves are more hardy. They are shorter in the leg and also in the carcass than the Devonshire oxen are, also higher and broader and heavier in the chine, rounder and wider across the hips, and more thickly covered with fat. The thigh is fuller and more muscular, and the shoulders are larger and coarser. The forehead is broad. The hide is thick, but mellow. The hair is soft, and at times curly. The males are very heavy, and much larger in proportion than the cows. The flesh is excellent. The animals are easily fattened, and when fattened they become much heavier than the Devons, and may be from fifty to seventy stone in weight. They are not much used for husbandry, although their form adapts them for rather heavy work, and they exhibit the docility of the Devon ox, and possess greater strength, if not the same activity. The Herefordshire oxen readily fatten, even when young, and hence it is of greater advantage that they should go to market at three years of age than that they should be kept for a longer time for the purpose of being employed as beasts of burden. The Herefords feed even more satisfactorily than the Devons do, and they will even grow fat in places where a Devon ox would scarcely live. The meat is finely grained and beautifully marbled, and these cattle are very highly prized in the meat market. But for the white face, slightly larger head, and thicker neck, it would not always be easy to decide positively if a given animal were a heavy Devon or a light Hereford. The white face

of the Herefords may possibly be due to their having been crossed with the Montgomery cattle. As a set-off against the good fattening qualities of the Herefords, it is to be remarked that the cows are rather bad milkers, and deficient in form. They are much worse from the point of view of the milk-supply than are the Devonshire cows. It is, in fact, very rarely the case that we meet with a dairy depending on Hereford cows. Nevertheless, although they are not good suppliers of milk as a general rule, some Hereford cows yield a large quantity. George Culley, writing in 1801 concerning the Hereford cattle of that date, says that the calves run with the cows until they are about eleven or twelve weeks of age, when they are weaned and turned out to grass; and also that a good Hereford cow, if well kept after the calf has been taken away from her, is capable of yielding 7 lbs. of butter per week for three or four months, and double that quantity of skimmed-milk cheese, but that these cows do not give such a large quantity of milk as the Suffolk cows do, though what they do give is of much richer quality. However, such a yield as this—a liberal one for any cow after rearing a calf—would not be forthcoming on the part of a modern Hereford cow. In point of fact, then, we find that the Herefords are good in regard to the production of meat; but that they are by no means remunerative for dairy purposes. Hence the cows are valued only, or very nearly exclusively, for their capacity in the way of breeding. They are small and delicate, and some persons would think them also ill-made. When in their usual condition, they are light-fleshed, and, moreover, they are not allowed to put on flesh while they are employed for breeding. When they are being fattened, they spread out and increase in size very rapidly. The Hereford cow is somewhat less than the ordinary size of cows, and not unfrequently produces a bull calf which may ultimately become three times her own weight. Very few Herefordshire oxen are grazed in their native county, and it is chiefly the heifers and old cows which are fattened for the home consumption. The oxen are usually sold when they are five or six years old, and in fair condition, at the Michaelmas fair in Hereford, to the graziers of Buckinghamshire and those of the counties lying adjacent thereto. The Herefords are well suited to the keeping up of good breeding qualities and of good form; but, unfortunately, these are not very compatible with the yielding

of a large amount of milk. The Herefords compare very favourably indeed with the shorthorns in respect to their capacity for being fattened by ordinary modes of feeding without being supplied with artificial food.

We propose to omit a consideration of the cattle of Gloucestershire, and, likewise passing over those of Kent, we come next to a short review of the cattle of Wales.

Now, it is to the Welsh oxen that we look for some traces of the native breed of cattle, for, as is well known, the inhabitants of Wales and those who retreated to that country as a place of refuge were never entirely subjugated by the early invaders. As for the Romans, they gained possession of only a portion of Wales, and the Saxons did not penetrate beyond the county of Monmouth. Furthermore, for a long time the sturdy Welshmen resisted the power of the English under the Norman kings, and it was not until a late period in the thirteenth century that the principality of Wales was actually annexed as an appanage of the English Crown. Howell the Good describes some of the Welsh cattle in the tenth century as being white and having red ears. In this respect they resemble the cattle of Chillingham Castle.

Speed says that Maud de Breos, in order to appease King John, whom her husband had offended, sent to his Queen a present from Brecknockshire of 400 cows and a bull, all white and with red ears. The same records which describe the "white cattle with red ears" also speak of the "dark or black-coloured breed," which now exists, and is generally met with throughout Wales.

The majority of the cattle of Wales and the most valuable of them are middlehorns. They are in some degree stunted in their growth, owing to the scanty food of the Welsh mountains; but they exhibit many of the points of the Devon, Sussex, and Hereford cattle.

The animals of North and South Wales are for the chief part reared in mountainous districts, where, even in the summer time, only scant herbage is found, while in the winter season the fare is very poor indeed. When between eighteen months and three years of age, they are sold to the English graziers in large herds, which are sold annually. They improve very rapidly when provided with rich pasturage. These animals are

hardy, and they supply some of our best beef. They are fairly good in so far as milking is concerned, and make very good crosses with the shorthorns, in some cases having given birth to steers which have taken prizes in the show-yards, in virtue of being endowed with splendid flesh, and in being hardy and easily fattened. Shorthorns are, however, preferable, since they prove more valuable in the long run. For about the first eighteen months the Welsh oxen will hold their own; but in the course of the next year or two a great difference is to be seen. Moreover, after the first cross, the offspring cannot be so greatly depended upon.

South Wales, Pembrokeshire.—The Pembroke and other Welsh breeds are not unlike the West Highland breed; but the cows yield a greater quantity of milk. The Pembroke cow or ox is a very useful animal, and the colour of most of them is entirely black. A few have white faces, or show a little white about the tail or the udder, and the horns also are white. The horns turn up in a manner which is characteristic of the breed. These oxen have shorter legs than most of the Welsh breeds; but the legs are longer than those of the Montgomery cattle. Their carcasses are round and deep, the hair is rough but short, and their hides are not thick. Their bones, although they are not so small as those of the improved longhorns are far from being large. In fact, the cattle of Pembrokeshire, to a great extent, combine the two qualities of being at once fair milkers and of possessing a propensity to become fat. In this connection it has been suggested, we may observe, that to fatten an animal, one should bleed it a little now and then. As a rule the meat of a Pembroke ox is of a fine quality, being beautifully marbled. It is, in fact, equal to that of the Scotch cattle, and some persons even prefer it. These cattle thrive in every situation, they will live where other oxen starve, and will rapidly outstrip most other cattle when provided with a sufficiency of good pasturage. In fact, the Pembroke cow is one of the best cottager's cows, and it is equally profitable to the larger farmer.

The Pembroke oxen are found in Caermarthenshire, Cardigan, and Brecon, and indeed in every bordering county, mixed with the different breeds of each, and imparting to each its best qualities. They are also very similar to the Kyloes.

The Pembroke ox is, like the Devon, a speedy and honest

worker, fit for the road as well as the plough, and when taken from work it fattens as quickly. A great many of them are brought to the London market, for which they are ready when about four years of age. The Pembrokeshire cow is generally black, and the face may be occasionally dark brown, or sometimes white. There may be a white line along the back. According to Mr. Davies, she is fine-boned, with a clean light neck and head, small yellow horns inclining upwards, good chine and loin, round long belly, thin thigh and short legs, is always in good condition if tolerably well kept, has wavy hair, and an oily skin. To this we may add that she is a fair milker, and will yield 5 lbs. of butter per week.

The cattle of Glamorganshire, those of Monmouthshire, those of Caermarthenshire, of Cardiganshire, of Brecknockshire, and of Radnorshire, we pass by.

North Wales.—The cattle of North Wales may be said to approach the next division — namely, that of the longhorns. They have, however, also a great deal of the characters of the middlehorns, with the exception perhaps of some of the Anglesey oxen. North Wales may be divided into two districts in one of which the rearing of cattle is almost exclusively attended to, while in the other the dairy is the matter of chief consideration. The first includes Anglesey, Carnarvon, and Merioneth, the second the counties of Denbigh, Flint, and Montgomery.

Anglesey.—The isle of Anglesey, called Mona in ancient times, the seat of Druidical superstition, and for a long time the stronghold of British independence, differs from the other divisions of North Wales in the fact that it does not possess a mountainous surface. There are only undulations or little hills covered with grass. Roberts, the author of the *Map of Commerce* published nearly 200 years ago, says that 3,000 head of cattle were annually caused to swim across the straits of Menai. The losses were then surprisingly few. At the present time about 10,000 are annually exported from the island. The iron bridge of Menai is now the means of transit. The Anglesey cattle are small, black, and hardy animals. Their chests are deep, their shoulders rather too heavy. The dewlap is enormous, the barrel round, the haunches are high and spreading, the face is flat, and the horns are long, and turn upwards. The hair is apparently

coarse; but the skin is mellow. It is an easy matter to rear them, and they can be readily fattened when they are taken to good pasture. Frequently they are fed on very scanty diet. It is the general opinion that the breed of Anglesey cattle, like that of Glamorgan, has somewhat deteriorated. The Anglesey cattle have not improved by being crossed, and certainly not by being crossed with the Irish oxen, which have been bought in numbers by the farmers on account of their cheapness. The breed is improving, and, when growing, the oxen are allowed a sufficient amount of food. Many Anglesey oxen are prepared for the London market in the midland counties and near London. Like the Scotch cattle, they thrive fairly well where an English beast would starve. Many yearlings come from Anglesey, and very few oxen remain there after they are three years old. The three-year-olds are the most valuable for the English grazier. They are eventually brought to the market when weighing from 60 to even 100 stones, and their flesh is more valuable than is that of larger cattle.

In Anglesey and throughout the greater part of North Wales, the black cattle were formerly extensively used for the plough, and even on the road. They were at once docile and hardy. They are now scarcely at all employed in this manner.

They have a very noble appearance. Formerly they were not cut until they were a year old, and hence they gained a fierce bull-like form about the head and dewlap, a projection of the breast, a lofty bearing of the head, a haughty look and a stateliness of gait. Early castration, however, is now practised, and the oxen are consequently becoming lighter about the head and dewlap. Formerly the oxen were a great deal smaller than they are now, and also far less numerous. No more cows are kept for the dairy in Monmouthshire than are required for home consumption.

On the English side of the straits of Menai are the cattle of Carnarvonshire, Merionethshire, and Montgomeryshire.

Denbighshire and Flintshire.—The Flintshire cattle are at once excellent milkers and quick feeders. A considerable amount of good butter is made in this district; but the attention of the dairyman is devoted to the making of cheese which, we may say, is equal to that of Cheshire. Every cow should produce nearly three hundredweight of cheese annually.

The Scotch breeds of cattle next present themselves for brief consideration. As a rule the Scotch cows yield only small quantities of milk, though what they do supply is of excellent quality, and when the cows are fed very well, the cream is of a peculiarly rich quality, and makes excellent butter. Consequently, it is not uncommon for dairy-farmers to introduce into their herds one or two Highland or Kyloe cows with the view of increasing the richness of the milk. These quaint and semi-wild Scotch kine are now only occasionally brought to the south to be fattened on the luxuriant pastures of England. This practice was formerly a very general one; but now-a-days the Scotch pasture-land is far more carefully cultivated than was formerly the case.

Scotland contains several distinct and valuable breeds of cattle coming under the denomination of middlehorns. The West Highlanders have remained unchanged for many generations, or perhaps have slightly improved. The North Highlanders are smaller, coarser, and inferior animals, and most of what is valuable about them is due to crossing with the Western breed.

The north-eastern cattle were derived from the cattle of the West Highlands to which, though much larger than them, they are still very similar. The Fife cattle are almost as valuable for the dairy as for the grazier, and they are active and docile. The cattle of the Ayrshire breed are surpassed by none in reference to their capacity for milking.

Again, many of the varied breeds of the Lowlands are valuable. The Galloways, which scarcely a century ago were middle-horned and only distinguishable from the West Highlanders with difficulty, are now polled, larger in size, closely similar to the Devons and endowed with all their aptitude to fatten, and with a hardiness of constitution which the Devons do not possess.

Of the North Highland cattle we propose to give a brief description of the Forfarshire or Angus breed. These cattle may be horned or hornless. The horned oxen are generally black; but some have white spots on the forehead, and are white on the flanks and belly. Some are brindled, some dark red, and others of a silvery yellow or dun colour. A few are black with white hairs intermingled. Now and again a beast is

seen which is altogether white with the exception of a few black hairs about the head. The Forfar horned cattle have shorter legs, thicker shoulders, rounder carcases, straighter backs, and, carry the head more elegantly than the Aberdeenshire cattle. The horns are shorter, better proportioned, curved upwards and forwards, and sharper at the points. We shall give a brief account of the Angus polled cattle under the heading of "Polled Cattle."

The "wild ox" now met with only in a few parks, as at Chillingham and Hamilton, is probably a descendant of the original bovine animals which inhabited many forest districts in Britain, and particularly those of the north of England and the south of Scotland. The wild oxen of Chillingham are much smaller than many of the domestic breeds; they have a graceful form, and are possessed of sharp horns which are neither very long nor greatly curved. Every calf which is not perfectly white is destroyed, and thus this white colour is becoming still more general. The habits of these wild oxen are very similar to those of the domesticated races. According to Mr. Culley, these oxen cannot be tamed, and consequently can only be kept within walls or good fences. The colour of the wild cattle of Chillingham Castle is cream white, but their muzzles are black. The whole of the inside of the ear as well as about one-third of the outside from the tips downwards is red, the horns are white, very fine, bent upwards, and provided with black tips. Some of the bulls are possessed of a thin and upright mane, which is about an inch and a half or two inches in length. The males weigh about 40 stones, and the cows about 30 stones (14 pounds being reckoned to the stone). The beef is finely marbled, and of excellent quality.

It is very advisable to keep at a distance from these animals. The cows hide their calves for about a week or ten days in some sequestered situation, and to this they repair twice or thrice every day for the purpose of suckling them. If any person should approach these little animals, they clap their heads close to the ground and lie down like hares to hide themselves; or perhaps, if irritated, they bolt at the legs of anyone who may be near, with all the force at their command. Moreover, the dams, if they see anyone touching their calves, will rush to the attack with headlong impetuosity. Again, if any one of a herd

of these cattle is badly wounded, or weak and feeble owing to age and sickness, the other members of the herd conspire together against their debilitated companion and gore him or her to death.

A few of the wild cattle are found in Androssan Park, which belongs to the Earl of Eglintown, and in Auchencruive Park, the seat of Mr. Oswald. They are cream-coloured, and have black muzzles, and black or brown or red ears.

The animals of the West Highland breed, or Kyloe, differ but very little from the Chillingham or Hamilton wild oxen, except as regards their colour, which is black. Their limbs are short and muscular, the chest is both wide and deep, the ribs are well arched, the back is straight, the horns are frequently rather long, the muzzle is short but not broad, and the skin is covered with shaggy hair. The milk is of a very rich quality, but very small in amount so that the cows are very unsuitable for dairy-farming. The beef is of the finest quality, and hence many cattle reared in the Highlands and in the Hebrides are annually taken to other parts of the country for the purpose of being fattened on rich pastures. One great point of advantage about the animals of this breed is that they are very hardy and likewise very well suited to the region in which they are found.

The Galloway breed is very similar to the preceding; but the animals are larger and devoid of horns, and many cattle are taken from the hilly parts of Galloway to be fattened on English pastures for the London market.

The animals of the Ayrshire breed, met with just over the border, are small but yet highly productive. They are very serviceable for dairy purposes, and are valued for their milk not only in Scotland, but also in other parts.

The Ayrshire breed stands in the foremost place in regard to milking powers. The animals of this breed are rather small, and their flesh is spread thinly over the body; but yet they can thrive fairly well even on second-rate and inferior pastures. Hence, in Scotland, the Ayrshire cow is preferred to others. The udders of the cows of this breed are hemispherical in shape, well formed, and provided behind with loose and soft skin. The milk is rich and well suited for butter-making, and the time during which the milk-producing powers continue is lengthy.

The Ayshire cows are noted not only for the great quantity, but also for the excellent quality of the milk they yield. On the other hand, they are not capable of being readily fattened, and their flesh is of an inferior description. Great care has been taken with the management of this breed in Ayrshire and the adjacent counties, in which dairy-farming is carried on to a marked extent. The horns of these oxen are smaller than those of the animals belonging to the West Highland breed; the hair also is much smoother, and the colour, for the most part, is brownish-red with large patches of white. Sometimes, however, they may be nearly entirely red. The patches may be almost fawn-coloured, and occasionally it may happen that prize Ayrshire bulls are greyish. The horns are short, they spread out a little near the head, and then turn upwards. Their heads are fine and tapering, the neck is thin, and the countenance has a pleasing look. The chines, backs, and hocks, are narrow, the ribs are flat, the belly is large, the buttocks are thin, the hair is thin, the hide is soft, and the bones are finely made.

The climate of Ayrshire is moist but mild, and the soil, with its produce, is such as to render it the best dairy country in Scotland, and equal to any in Great Britain. The pasture-ground is occupied by the beautiful dairy-stock, a very small portion of it being kept for cows too old to be milked. According to Mr. Aiton, the most approved shape of the dairy animals is as follows:—

Head small but rather long and narrow at the muzzle; eye small but smart and lively; horns small, clear, crooked, and having their roots at a considerable distance apart from each other; neck long and slender, tapering towards the head and with no loose skin below; shoulders thin; fore-quarters light; hind-quarters large; back straight and broad behind; the joints rather loose and open; carcase deep, pelvis capacious, and wide over the hips, with round fleshy buttocks; tail long and small; legs small and short, with firm joints; udder capacious, broad, and square, stretching forward, and neither fleshy, low hung, nor loose; the milk veins large and prominent; teats short, all pointing outwards, and at considerable distance from each other; skin thin and loose; hair soft and woolly; the head, bones, horns, and all parts of least value small; and the general figure is compact and nicely proportioned.

The breed has greatly improved since Mr. Aiton described it. The animals have short legs, the neck is a little thicker at the shoulder, but finely shaped towards the head; the horns are smaller than those of the Highlanders, but clear and smooth, pointing forwards, turning upwards, and tapering to a point. They are deep in the carcase, but not round and ample, and particularly not so in the loins and haunches. An Ayrshire cow may give on an average as much as five gallons of milk daily for two or three months after calving. Then for the next three months she may give three gallons daily, and for the four months following this about one gallon and a half. The average quantity per year from each cow may be about 600 gallons, worth, if sold as new milk, say, 8d. per gallon, or £20 per annum. The profit may be greater if the milk is used for fattening calves, or perhaps if converted into butter or cheese. Three and a half gallons of this milk will yield about a pound of butter (country weight). When one gallon of water is added to four of milk, the butter-milk will sell at 2d. per gallon.

The Ayrshire cattle feed profitably, and their meat is of good quality. When an Ayrshire cow is sent to England, she loses her superiority as a milker, and begins to accumulate flesh.

In the Eastern Counties, where arable farming and the rearing and feeding of cattle are mainly pursued, the Ayrshire gives place to the Aberdeen, the Angus, and the Teeswater. The cow is there selected on account of its square and massive frame, soft skin, and fine meat-producing qualities. The animals of the Shetland breed are very small and hardy, and noted for the fine quality of their beef. They are easily fattened, even on scanty pastures, and their diminutive size being considered, the quantity of the milk they yield is very large.

THE POLLED OR HORNLESS CATTLE.

Hornless or polled cattle are met with in the counties of Suffolk and Norfolk and also in Galloway, whence they originally came.

Now it appears to be the case that the remnants of two distinct breeds of cattle are found in the parks of Chillingham, in Northumberland, and of Chatelherault, in Lanarkshire. One of these consists of middle-horned and the other of polled cattle. The former of these are to be traced in the Devon, the Hereford,

the Sussex, and the Highland cattle, while the latter are represented by the oxen of Galloway, by the Angus Humlies, the Suffolks, and the Norfolks.

The Suffolk Dun is a hornless breed, being, in fact, the only true hornless breed found in England, and it is supposed to have been derived from the polled breeds of Scotland. These animals are clumsy in form, and they are of but little value to the grazier, although they yield a very large quantity of milk and are, in fact, noted for their dairy produce, their rich milk, butter, and cheese. The colour is light dun or yellowish cream, light red, or red and white. The carcase is usually rather narrow and flat, the legs are short and thin, the ribs are well arched, the belly is heavy, the chine thin and hollow, and the loins are narrow. The head and throat are nicely proportioned, and the dewlap is not large. The udder is large and square, and the milk veins are large. The skin is fine, and the hair is of a silky texture. The Suffolk cow presents an angular or bony appearance, and does not display the fine rounded outlines of the Shorthorn, the Devon, and the Hereford. When dried, and fed on liberal diet, the cow is capable of being quickly fattened, and it is probable that the breed might be more widely utilised for our dairies, both as a distinct breed and for crossing purposes.

Galloway.—As late as the middle of the last century the greater number of the Galloway cattle were horned. They were middlehorns, but some of them were polled. For more than 150 years the surplus cattle of Galloway had been sent far into England, and principally to the counties of Norfolk and Suffolk. The polled beasts were always liked by the English farmers. They fatten well, attain a large size, and they are not at all wild and fierce. The horned breed was at length quite superseded by the polled, except that now and again a few of the Galloways might have diminutive horns; but these were attached to the skin and not to the skull.

The Galloway cattle are straight and broad in the back and nearly level from the head to the rump. They are round in the ribs, and between the shoulders and the ribs, and between the ribs and the loins. They are broad in the loin without having large projecting hook-bones. They show a roundness of barrel and a fulness of ribs. When looked at from above, the whole body looks beautifully rounded. They are long in the quarters and

ribs and deep in the chest. There is less space between the hook or hip-bones and the ribs than in most other breeds, so that there is as little space as possible lost in the flank.

The Galloway has short legs, and moderately fine shank bones. The leg is just strong enough to preserve the hardihood of the animal. The neck is thick, the head rather heavy, and the eyes are not prominent. The ears are large, rough, and full of long hair on the inside. The skin is loose, mellow, and of medium thickness, and the hair is long, soft, and silky. The skin is thinner than that of the Leicestershire, but not so fine as that of the improved Durham, breed, albeit it is soft to the touch. Most of these cattle are black, a few are dark brindled brown, and still fewer are speckled with white spots. Some are of a dun or drab colour, which may, perhaps, have been acquired from a cross with the Suffolk breed of cattle. Those which are dark in colour are preferred. According to Mr. Culley, these cattle resemble the longhorns both in colour and shape excepting in the fact that they have no horns. Their form is shorter, and their weight less. Their hides stand midway between those of the longhorns and those of the shorthorns, in being not so thick as the former, and not so thin as the latter. They put on fat in the best parts, and their beef is well marbled or mixed with fat. They are for the most part bred upon the moors or hilly country in Galloway, until rising four or five years old, when they are taken to the fairs in Norfolk and Suffolk, previously to the time for being fed on turnips. The greater number of them are then removed when fat, in the winter and spring, to the London meat-market. It is estimated that more than 30,000 of them are annually sent to the south. In the few districts of Galloway where cows are introduced they are of the Ayrshire breed, which are much better milkers than are the Galloway cows. The calves are reared in a manner which is peculiar to Galloway, being permitted to suck the mother more or less, beginning from the time when they are born, and continuing to suck as long as she gives milk. For the first four or five months they are allowed a liberal supply both morning and evening, usually more than half the milk of the cow. The dairymaid takes the milk from the teats on one side, while the calf draws it at the same time and exclusively from the other side. When the calf begins to graze a little, and is turned upon

the best young grass on the farm, it is not allowed to suck for so long a time. In winter the calf is housed during the night, and fed upon hay with a few turnips or potatoes; for, if stinted during the first fifteen months, the animal does not attain the natural size, nor does it feed so well afterwards. The Galloway farmer holds that an ostensible difference can be discerned betwixt the calf that sucks its dam and another fed from the pail; that while the coat of the former is sleek and glossy, indicating health, the hide of the other is dry and hard, and that this unthrifty appearance is not removed until some time after the animal has been weaned and fed entirely on grass, and, finally, that a calf fed from the pail is more liable to die of stomach complaints than one brought up according to the method above described. The calves should be born in the latter part of winter or the beginning of spring. Rarely do the Galloway breeders sell their calves for veal. The Galloway cows do not give a great quantity of milk; but that which they do give is rich in quality, and yields a large proportion of butter. The average amount of milk given by a Galloway cow is about seven quarts per day during the five summer months after feeding her calf. During the next four months she does not give more than half that quantity, and for two or three months she is dry. Young Galloway cattle are said to be especially liable to two diseases known as redwater and quarter-evil respectively. The former disease is dealt with by administering a few doses of Epsom salts at an early period, and then removing the young animal to good young grass where the land has been recently limed. The latter disease is best dealt with by setoning the animals as a preventive. When the Galloways are two years of age, they are, as a rule, hardy animals.

There is probably no breed of cattle which can with greater truth be said to be indigenous to the country and incapable of improvement by any foreign stock than the Galloways. The shorthorns have almost everywhere else improved the cattle of the district into which they have been taken, at least in the first cross. Even in the first cross, however, the shorthorns have done but little good in Galloway, and as a permanent mixture the choicest shorthorn bulls have obviously failed. It seems that the Galloway cattle can only be improved by adherence to the pure breed, and by careful selection of the best animals of both

sexes. These cattle are very docile, and it is even rare to find a bull furious or troublesome.

The cattle of Dumfries are also polled.

There have always been some polled cattle also in Angus.

The Norfolk cattle and those of Suffolk are also polled.

THE IRISH CATTLE AND THE LONGHORNS.

Having now briefly considered both the middlehorns and the polled cattle, we pass on next to a very cursory description of the Irish cattle. Ireland is noted for the far-famed Kerry cow as well as for other kinds of cattle; and to some districts of Ireland the English shorthorns have been brought, greatly to the improvement of the herds previously present therein. There are two distinct breeds of Irish cattle—namely, the middlehorns and the longhorns. It is clear that the former of these are an aboriginal breed. They occur on the mountains and in the ruder parts of the country, being met with in almost every district. They are small, light, wild, and active, animals. The head is frequently small, but not small in the case of the cattle of every district. Some Irish cattle have thick heads and necks. As the name middlehorns leads us to infer, the horns of the cattle so designated are shorter than those of the other breed. They are also fine, some are somewhat upright, and after projecting forward they may in many cases turn backwards. Although a little deficient in the hind quarters, these oxen are high-boned, and wide over the hips; but the bone generally is not heavy. The hair is coarse and long. In some places the cattle are black, in others brindled, and in others black or brindled with white faces. Some are finer in the bone and finer in the neck, have a good eye and a sharp muzzle, and are very active.

They are very hardy animals, and may gain flesh even in the winter time on their native mountains and moors. When taken to a better climate and a more fertile soil, they fatten with great rapidity like the aboriginal cattle of Wales and the Highlands. They are, as a rule, very good milkers, and may be even excellent in this respect. When they have much of the Kerry blood in them, they are very wild, and can leap even the highest fences and the broadest ditches.

The Kerry cow lives well almost everywhere, yields a great

amount of milk, and fattens rapidly when fed with that end in view. The Kerry cow is of a black, or greyish colour, and may be brindled, is a good supplier of milk, and a very remunerative, hardy, and active little animal. The head is finely made and of small dimensions, the eyes are bright, the horns short and turned upwards. The body is rather round and long, the legs are short, the hind quarters are light but high-boned, and the animal is wide across the hips. The Kerry cow differs both from the larger and the smaller longhorned Irish breed and from the North Devon middlehorned cow by the cloddiness about the shoulders, and the shortness and thickness of the lower part of the neck. These cattle are usually small, and confined to the hilly and moory grounds, or to the more restricted area of the cottager and small farmer. This breed is composed of cattle of considerable size in Connaught, and these are improved in form as well as in weight. The horns are generally of middle length and turn upwards, as also do the horns of the cattle on the mountains; but they are shorter in the leg, and shorter in the body. Their loins and haunches are heavy and wide, the hair is thick, the hide is mellow, and they thrive more quickly than any other breed.

The other breed is of a larger size, and composed of the old or partially improved Craven, or Lancashire beasts, the Longhorns.

They very closely resemble the English longhorns, and have been materially improved by having been crossed with them; but it is very difficult to say whether Ireland or England was the native country of this breed. Thousands of Irish beasts annually traverse almost every part of Great Britain, from Port Patrick to the Thames, and it is quite possible that the English longhorns sprung from some of the Irish ones which stopped at different places in the course of their journey.

Almost every county and barony of Ireland had its zealous and successful improver of the native breed, until, in the richer and more highly cultivated districts, the cattle became as large and as perfect as any which the Midland districts of England could produce. Possibly, however, there were two distinct breeds of long-horned cattle. At any rate at the present time there are two kinds of cattle in Ireland possessing quite different characters. The larger are greatly preferable to the smaller

kind of Irish longhorns. These latter possess very long horns, clumsy heads, large bones and thick hides, bulky dewlap, and, in fact, they have many defects. Thousands of these, and more perhaps than of the improved breed, are brought to the midland counties of England, in order to be prepared for the Metropolitan market. They vary greatly in regard to the way in which they thrive. In the course of time the English longhorns began to lose ground even in their native county, in proportion as the improved shorthorn cattle began to attract the attention of the breeder, owing to their propensity to fatten and the comparatively early period at which they arrived at maturity. The agriculturists of Ireland quickly availed themselves of the method of improving the Irish cattle by introducing the shorthorns. The pure shorthorn, or the first cross of longhorn and shorthorn weighed as much at three years old as a pure longhorn at five. The breed, however, rapidly degenerated; but more systematic and more successful attempts have been made to introduce the shorthorn blood.

Before the establishment of steam navigation, many difficulties attended the transport of the Irish cattle. Formerly many were driven even as much as 150 miles to the coast, where, if the wind was contrary, they were detained, perhaps several days, being allowed but very little food during the time of their stay. No food was given to them on the voyage, and when they arrived at the English shore they were often so weak, owing to want of food, that they could not walk. In these days, however, a steam packet with a cargo of fat cattle will leave Ireland one day, and have delivered on the next day. Again, cattle may now be slaughtered in the evening at any of the ports on the eastern coasts of Ireland and sent to Liverpool, and even to Manchester in time for the next day's market. The old breed of Irish cattle is most valued for the dairy, since they give, in proportion to their size, a much greater amount of milk than the longhorns do, and it is, moreover, richer in butter. A cow gives about 98 lbs. of butter per year. A very good cow will yield $1\frac{1}{2}$ cwt., about half of which quantity is consumed by the family or in the country, while the remainder is exported to England. Very little cheese is made in Ireland, and that which is produced there is usually of an inferior quality.

We next proceed to give our readers a very brief description of the English longhorns. The earliest records inform us that a peculiar and valuable breed of cattle, the horns of which were very long, existed in the district of Craven, a fertile corner of the West Riding of Yorkshire, bordering on Lancashire. These longhorned cattle gradually spread along the Western coast of England, and, after they had been greatly improved by a well-known breeder called Bakewell, they gradually established a footing throughout the greater part of the midland counties. At the present time they are rapidly being replaced by the short-horns. As their name implies, these longhorned cattle are easily distinguishable by the great length, and sometimes also by the cumbersome form, of their horns. In the animals of the old Craven breed the horns often projected in a nearly horizontal direction on each side. However, in the case of the improved Cravens, which are very valuable animals, the horns either grew downwards in a perpendicular direction, thereby rendering the act of grazing a difficult operation, or else in a curved form so as to present an appearance as if they were about to meet or cross in front of the muzzle, and thereby also hinder the animal in the process of grazing, or altogether prevent it from doing so. Or perhaps they might look as if about to grow down beneath the under jaw so as to lock it, or as if they were about to pierce the bones of the nose, or certain other parts of the face. The horns first take an outward direction, then curve and may return towards the face. In this connection we may say that the growth of the teeth in certain rodents presents some resemblance to this.

Most of the modern English longhorns are possessed of long, spreading, and sometimes drooping horns. They are dark red and brindled in colour, white along the back, have good coats of hair and rather coarse bones, are fairly symmetrical in build, have a great amount of flesh along the back, a capacity of attaining great weight, and of sound and rather rapid feeding. Even the Craven group, however, like the whole of the Irish longhorns, though with no such wide difference of value, are divisible into two great and very distinct sections. The smaller Cravens inhabit the moorlands and hills, are hardy, and easily kept, yield a great quantity of excellent milk, and quickly fatten when put upon rich pasture. They are, as a matter

of course, greatly prized by cottagers and those who have small farms, on account of the small expense at which they can be kept, the rather large amount of excellent milk which they supply, and the rapid rate at which they fatten when placed on good pasturage. On the other hand, the larger cows of the Craven breed, which occupy lower, more level, and richer soil, are fairly good in regard to the supply of milk, albeit that they are not equal to the smaller Cravens in this respect in proportion to their size and the quantity and quality of the food they take. They have a special tendency to fatten at a rapid rate, and they acquire a large bulk, which is scarcely less, in fact, than that of the shorthorns of the present day.

Now, as either of these two kinds of Craven cattle found their way to other districts, they were mixed to some extent with the native cattle, and also gradually became adapted to the changed conditions of climate, soil, and environment—in short, to their new surroundings. Consequently the cattle of Cheshire, those of Derbyshire, of Nottinghamshire, of Staffordshire, of Oxfordshire, and of Wiltshire, were all essentially longhorns; but each variety developed in course of time its own distinguishing features, which seemed to adapt it for its own particular situation. On the other hand, the old breed of longhorns remained much the same. It was formerly the case that the cattle of this breed were preferred to every other breed; but at the present time they are known to be inferior to the shorthorns, and from the point of view of the flesh they yield they are not equal to any one of several Scotch breeds.

Robert Bakewell, who was borne at Dishley, in Leicestershire, in the year 1725, was, as we have above said, the chief improver of the longhorns. The most general principle which guided him was probably beauty of form. This point was more closely attended to at the outset than at present, practical men now making a distinction between a useful sort and one which is merely handsome. Evidently, utility of form is more important than beauty of form; and the parts which make offal should, so far as is consistent with all desirable powers of constitution and so forth, be small in proportion to the better parts. Again, the grain of the meat depends wholly on the breed, and not on the size of an animal, and one important point is the power to

acquire fat at an early age and rapidly, a quality which has been found to be hereditary.

It appears, in fact, to have been Bakewell's opinion that all depends upon the breed and the beauty and utility of the form, the quality of the flesh and the propensity to fatten on the part of the offspring being the natural consequence of similar qualities in the parents. Mr. Bakewell's plan was to unite the superior branches of the same breed. The rapidity of the improvement which he effected was only equalled by its extent. His stock was unsurpassed for roundness of form, smallness of bone, and aptitude to acquire external fat; but at the same time their milk-producing qualities were considerably lessened. Other breeders also aided in improving the longhorned oxen. The result was that in the districts in which the experiments were tried a breed of cattle, equalled by few and excelled by none but the Herefords, was produced. In fact, the whole breed of the longhorns was improved. The cattle of Lancashire, Derbyshire, and Staffordshire became, and still are, an improved race, and they got rid of a portion of their coarse bone. They put on flesh and fat in the more suitable situations, they became mature at a somewhat earlier age, and the dairy cattle to some extent acquired a tendency to convert their food into milk while milk was wanted, and after that to use the same nourishment for the accumulation of flesh and fat. The Irish breeders owe everything to the new Leicester cattle, and indeed a new stock has arisen since the improved longhorns were grafted on the native Irish stock.

The principle on which Mr. Bakewell seemed to act in breeding so closely *in-and-in* was a novel, bold, and successful one. He had a large stock on which to work, and no one knew what were his occasional deviations from this rule, nor how he skilfully interposed remoter affinities when he saw or apprehended danger. When the masters of that day had disappeared, the character of this breed began to deteriorate slowly, and, in fact, so refined were many of them that the propagation of the variety was not always certain. Moreover, the improved shorthorns began to occupy the banks of the Tees, they presented greater bulk, equal aptitude to fatten, and they arrived at maturity at an earlier age.

The county of Westmoreland had been the native land of the longhorns; but even in that county the shorthorns made good

their footing, spread, established themselves, and in a manner superseded the longhorns. They found their way to southern districts, mingled with the native breeds, and it was found that a cross from them usually increased the amount of milk, the aptitude to fatten, and the earliness of maturity. The advantages of the improved longhorns remained ; but the breed itself gradually diminished. In some places it almost disappeared ; and at the present time, and even in Leicestershire, the shorthorns are fast driving the longhorns from the field. To the historian it might almost seem as if some dread scourge had suddenly swept away the whole of this valuable breed.

THE SHORTHORNS.

As the name itself manifestly implies, the famous breed of cattle known as the " Shorthorn " is characterised by the fact that the animals so-called have shorter horns than almost any other kind of oxen. They possess, in a high degree, a rare combination of good qualities, being very attractive to the eye by reason of their splendid frames and beautiful and varied colours. These animals were first produced at the beginning of the nineteenth century, having been originally bred in East York and afterwards greatly improved in the county of Durham. In fact, these two counties of York and Durham have for a long time been noted for their shorthorns, which were remarkable, in the first instance, principally on account of their great capabilities in regard to the supply of milk. From this district these oxen have spread very extensively both in England and in Scotland, and they are now met with in nearly all the best grazing districts. At first the shorthorns were usually large, thin-skinned, sleek, delicate, coarse in the offal, and rather deficient in the fore-quarters. They were good milkers but slow feeders, and their meat was inferior, not marbled, and rather dark in colour. The shorthorns which have not been improved at the present day are very similar to the original shorthorns. After the lapse of eighty years the shorthorns existing near the banks of the river Tees—on this account denominated the Teeswater breed—had assumed characters very different from those above described. They were occasionally red, red and white, and roan, although the last-named colour was at that time not so prevalent

as it now is. They possessed a fine mellow skin and flesh, good hair, light offal, very wide carcases, and very deep and large fore-quarters. No doubt the judicious and careful breeders who dwelt on the banks of the river Tees crossed the original shorthorns with other breeds, and it is very possible that one of these was the white wild breed.

A great many persons might be mentioned as having been connected with the breeding of shorthorns; but we may merely refer to Mr. George Coates, the author of *The Shorthorn Herd Book.* This gentleman was very highly successful, but he certainly made one mistake in not liking to cross his own stock with that of other breeders.

One of the chief characteristics of the shorthorns is that they arrive at maturity at an early age. Their capability of continuing their growth has excited the wonder and approval of all who have had to do with them. Not only are they fairly good in regard to milk supply, but they also possess the power of fattening rapidly. Indeed, the latter capacity is so marked, and the improvement in the carcase of the shorthorn has been so surprising, that many persons have allowed that point to occupy their entire attention, and hence the supply of milk having been neglected has fallen off in consequence. Nevertheless, there are to be met with, improved shorthorns, *i.e.* shorthorns which have been very carefully bred, which are not only very suitable for grazing purposes, but also possessed of most valuable dairy properties. Some of the best-bred shorthorn cows may yield upwards of four gallons of milk night and morning, and may give even as much as 20 lbs. of butter per week.

Many excellent beasts have been bred from improved shorthorn bulls and longhorn cows, especially those of Devon. A friend of Mr. C. H. Bolton bred with shorthorn bulls from about a dozen North Devon cows of small size but nice quality, and the consequence was that all his stock were good milkers. It is said that occasionally shorthorn bulls may be moderately worked with advantage; but, as a rule, shorthorns, which are as profitably consigned to the butcher at two years old as other kinds of cattle at four, ought not to be placed in the yoke.

The shorthorns are now very carefully looked after, and they are more particularly bred in the northern counties and in Lincolnshire. It may, in fact, be said that they are the best

cattle found in Great Britain, and hence we are not surprised that these English shorthorns are met with in many parts of the Continent of Europe and also in America and elsewhere. For more than a hundred years the greatest care has been taken to improve the breed. Genealogies have been recorded, and the pedigrees of both sires and dams can be traced back for many generations; and the enormous sums of money at which first-rate bulls and cows of this breed sell, show in what estimation shorthorns which are nearly perfect are held. The colour varies from pure white to bright red, and it may be dark red, red and white, or roan. If any black hue is apparent, it is due to an admixture of other breeds. The improved shorthorns may, then, be said to be red or white, or red and white combined in various degrees. It is highly probable that the white colour arose in the first instance from a cross at an early date with the wild white breed. The tip of the ear in the case of the white shorthorn, like the extremity of the ear in the wild oxen, is characterised by a red tinge. The head is short and very broad, the chest is wide and deep, and projects forward. The fore-legs are short, the back is straight but not very long, and the barrel is full. The animals of this breed are capable of being very readily fattened, and their beef is of a very excellent quality. On the other hand, the shorthorn cows are not so valuable from the point of view of the dairy as are some other breeds. One good point about the shorthorns is that they impart their excellent qualities to their offspring when they are crossed with animals of other breeds. The progeny which results from such crossing possesses the capability of being very easily fattened and of growing to a large size. By way of illustration of this, it may be said that a cross between a shorthorn bull and an Ayrshire cow gives rise to offspring which are valuable at once in regard to their beef and also in respect to the supply of milk. Moreover, another point of excellence possessed by the shorthorns is that these animals can readily adapt themselves to different conditions of place and soil, and they are also capable of being readily fattened. In Lincolnshire and other districts where the pasture-land is rich, the first batch of large oxen can be removed from pasture in June, and the next lot before the beginning of winter. However, as a rule, the shorthorn cows, as we have said above, are not good suppliers of milk, the milk being only moderate in

amount, of very variable quality, and only seldom given for a long period. For three months they may yield an abundant supply, then the amount may suddenly be reduced to half the previous quantity, and soon they may yield none at all. Few shorthorn cows give milk for longer time than about seven and a half months. However, after they have been used for the purposes of the dairy they can in the general way be quickly fattened for the meat market.

We may now briefly give the characters of a milch-cow which is valuable for the dairy and capable of afterwards being quickly made ready for the market. The head should be long and rather small; the eye should be bright, but yet it should manifest a placid expression; the chaps should be thin, and the horns small; the neck may be thin where it joins the head, but it ought soon to thicken a little, and particularly as it approaches the shoulder; the dewlap should be small, the breast ought by no means to be narrow, and, on the other hand, it ought to project in front of the legs; the chine may be slightly fleshy and even full; the girth behind the shoulder ought to be deeper than it generally is in the cows of the shorthorn breed; the ribs ought to spread out widely so as to impart a globular form to the carcase, and each successive rib should project out more markedly than its predecessor as far as the loins. The cow should be well formed and symmetrically proportioned across the hips and on the rump, and there ought to be greater length in that part than is usually the case in milch-cows. The thighs should be somewhat thin and slightly crooked or sickle-hammed. As for the tail, its upper part ought to be thick, but it should taper below. The hide should be mellow; the milk-veins ought to be large, inasmuch as large milk-veins indicate good power of secretion of milk. The udder likewise should be large; but, on the other hand, that organ may be too large. In fact, the udder ought to be sufficiently capacious to contain the correct amount of milk; but if it be too bulky, one might suspect that it may be thickened or loaded with fat. The skin of the udder ought to be thin and free from lumps throughout its whole extent. As for the teats, they should be of moderate size, situated at equal distances apart from each other, and they ought to be of an equal size from the udder almost to their extremity, at which, however, they should run to a kind of point. If they are too

large near the udder, they allow the milk to flow down too freely from the bag, and then that fluid is lodged in them. Sometimes they may be too broad at the end; and, indeed, the orifice may be so large that the cow cannot retain her milk when the bag begins to be full. Moreover, the hinder part of the udder ought to be of a size nearly equal to the front portion of it. Perhaps the udder should be a little broader and fuller in front than it is behind.

The following well-known doggerel lines describe the points of a good cow.

She 's long in her face, she 's fine in her horn,
She 'll quickly get fat without cake or corn;
She 's clean in her jaws, and full in her chine,
She 's heavy in flank, and wide in her loin.

She 's broad in her ribs, and long in her rump,
A straight and flat back, without ever a hump;
She 's wide in her hips, and calm in her eyes,
She 's fine in her shoulders, and thin in her thighs.

She 's light in her neck, and small in her tail,
She 's wide in her breast, and good at the pail;
She 's fine in her bone, and silky of skin—
She 's a grazier's without, and a butcher's within.

Some of these shorthorn cows give in the beginning of summer as much as thirty quarts per day, and sometimes, though rarely, they have been known to yield as much as thirty-six quarts. The average amount may be estimated at about twenty-three quarts. It seems that the shorthorn cows are not so very good in regard to butter, and also that they improve in that respect as they grow older.

FOREIGN BREEDS OF CATTLE.

Alderney Cattle.—There are two kinds of so-called Alderney cattle, namely, those which come from Normandy, are larger, and have a superior tendency to fatten, and secondly, those which are imported from the islands on the French coast. Whether from the continent or from the islands, they all, when in England, pass under the name of Alderneys. These crumpled-horn, or Alderney, cattle are met with on the southern coast, and, in smaller numbers, in gentlemen's parks and pleasure-grounds in all parts. They are similar to the cattle of Ayrshire in certain points; their milk is comparatively small in quantity, but noted

for its rich cream, for which reason Alderney cows are often kept for private dairies. If the milk of an Alderney cow be mixed with that of a dozen other cows, the butter will be of better quality. As a set-off against their excellent milk-giving properties, the Alderneys are useless for grazing purposes. With the exception of the county of Hampshire, they are kept scarcely anywhere but in the parks of the rich, by whom they are prized on account of the exceptionally-fine quality of their milk and the large amount of butter which it yields, occasionally, perhaps, also on account of the smallness of these animals. According to John Lawrenee they are light-red, yellow, dun, or fawn-coloured, short, wild-horned, deer-necked, thin, and small-boned, and irregularly, and often very awkwardly, shaped. The Alderney has a voracious appetite, but yields very little milk, although that little is, as we have said, of exceptionally excellent quality, and is capable of producing a greater quantity of butter than can be obtained from the milk of any other kind of cow. On the coast of Hampshire, where these Alderneys can be very readily procured, they are much sought after. A good point about the cows is that when they have been dried they fatten with great rapidity. This is scarcely what might be expected if we consider their gaunt appearance. Some persons have been disposed to believe that the Norman cattle have had something to do with the improvement of the shorthorn breed.

Of East Indian cattle several varieties have been imported, and attempts have been made to naturalise them.

Of the Nagore cattle, a bull and cow, the property of Henry Perkins, Esq., were exhibited in the year 1832 at the Christmas cattle show, at which they attracted much attention. They are not buffaloes, but belong to the highest breed of Indian cattle. In India they are employed by the higher classes for the purpose of drawing their state carriages, and, being greatly valued for their size, speed, and endurance, they fetch very high prices. Colonel Skinner, who bred these animals, possessed a great number, and six or seven of them were always kept ready saddled in order to carry the military despatches. They can carry a soldier on their backs for fifteen or sixteen hours in the day, travelling at the rate of six miles an hour. Their action is said to be very fine, and they bring down their hind legs under them in as straight a direction as the horse does. They are, moreover, very

active, and can clear a five-barred gate with the greatest ease. Mr. Perkins possessed a calf which leaped over an iron fence higher than any five-barred gate; and the bull frequently jumped over the same fence in order to get to the water, and, when he had drunk his fill, leaped back again.

The bull (Jupiter) was in high condition when exhibited. He was employed in a light cart in various jobs about the farm, and drew the light roller over the ploughed land, being docile and tractable when one particular man drove him and attended upon him; but he now and then showed symptoms of dislike to others. He was fed entirely on hay, except that when he worked, a little bran was given to him, and in the turnip season he was treated now and again with a few slices of swedes, of which he was very fond. At first it was very difficult to shoe him; and it was necessary to erect a break in order to confine him for that purpose. He liked being noticed, and frequently, when he was lying down, if anyone to whom he was accustomed went and sat down upon him and stroked him over the face, he would turn round and put his head on their lap, and lie there contentedly for a long time. These Brahmin bulls are very strong and swift animals. The cow was out at grass with the milch cows, and up with them morning and evening when they were driven to be milked; but she was not milked, on account of the probable danger of the attempt. Two calves were bred from them.

Buffalo and Indian Cattle.—The Duke of Northumberland has a fine breed of buffalo cattle in his picturesque park at Alnwick. They are not of the pure Indian breed, but have been crossed with the Highland kyloe, the original bull having died soon after their arrival at Alnwick. There were about thirty of them, and only one or two bulls were allowed to be among them at one time. They have promiscuously bred among each other, care being taken to preserve those for breeders which possessed a rather large characteristic hump on the shoulder. They are treated in great measure like the other cattle, except that it has been thought wise not to handle them. During severe weather they have a hovel to run into, and although they do not seem to bear the cold weather so well as one kind of the progenitors—the Kyloes—they are usually very healthy.

When the calves are dropped, the mother endeavours to secrete them in the long grass for a few days, like other wild cattle, so

that the herdsman has to watch the place and a favourable opportunity to castrate or spay them. They graze well, the young ones getting into excellent condition in the summer. They lose flesh in the winter, yet by the time they are killed towards the close of the year, when four or five years old, they give very good beef. The meat is finely marbled and well flavoured.

In Wentworth Park, the chief seat of Earl Fitzwilliam, there is a herd of very fine Indian cattle. They were presented to Lord Rockingham by Mr. Verelst, who was at that time Governor of Bengal. Their meat is not very pleasant to everyone's taste. Some of the calves were castrated; but they did not seem to thrive so well as those that were left in their natural state. In winter they are driven into a yard provided with sheds; for they would almost starve in the open ground.

Another variety of cattle is met with in the Roman States. These oxen are generally of a bluish ash colour, and they are possessed of very large and spreading horns.

A large white breed was for a long time kept in Egypt, and a similar breed, devoid of the hump, characteristic of the Indian ox, is met with in South Africa, in which country, however, it has become partially intermixed with European breeds. The Kafirs, and, indeed, also the white inhabitants of South Africa, employ oxen very extensively as beasts of burden, and in former times they were even trained by the Hottentots to aid them in battle. In fact, the intelligence of the South African ox may in these cases even exceed that of the horse and even the sagacity of the dog. Peter Kolben, in his account of the Cape of Good Hope, written in the year 1705, gives a description of these trained fighting oxen called backeleyers. It appears that their oxen are the faithful servants and companions of the Hottentots —of whom not very many are now extant—the sharers alike of their pleasures and of their fatigues. They are at once the protectors and the servants of the Kafir, and help him to tend his flocks and to guard them against invaders. While the sheep are grazing, the faithful backely—so this kind of ox is designated —stands and grazes beside them, and, attentive to the looks and directions of its master, hastens now and again round the field, keeping the straying sheep within their proper limits, and showing not the least mercy to robbers nor even to harmless strangers who may happen to be nigh at hand. Moreover, an army of

Hottentots contains a herd of these creatures, which, when let loose against the enemy, overturn men and everything in their way, striking with their horns and trampling with their feet everyone who opposes them, and frequently procuring for their masters an easy victory. In the internecine wars of the Hottentots one with another these animals (backeleyers) work terrible havoc, goring and kicking and trampling to death with almost incredible fury. They are, however, while not excited in the struggle, very docile creatures, and personally know every inhabitant of the kraal, being quite harmless to them, but, on the contrary, very ferocious towards, and ready to run with fury at, any strangers. The backely lives in the same cottage as its master, for whom the animal displays feelings of affection. When the creature dies, a new backely is selected to succeed him by a council composed of the old men of the village. The newly-selected backely is then placed with one of the veterans of his own kind, and from him he learns his art, and is taken for the term of his life into direct friendship by his master.

The readiness with which the draught oxen of South Africa observe and obey the words of the driver is said to be very great, although in the process of training them severe measures are often required, particularly that of inserting a hooked stick through the cartilage which separates the two nostrils. This reminds us of our modern method of ringing bulls before sending them to exhibitions of cattle. Moreover, oxen which have been already trained are employed for the purpose of training younger oxen. Again, in some parts of Africa the ox is employed for riding as well as for draught. In this case the horns, which are very long, are first split up into ribbons and shreds, or, perhaps, curved in various directions, in order to obviate the possibility of their points coming into contact with the person of the rider in consequence of any untoward accident. The pace of an ox is slow, seldom exceeding four and a half miles an hour. We may conclude our brief review of foreign cattle by the observation that some of the herds of oxen found in South America have a skull of peculiar conformation, the bones of the nose and the jaw-bones being very short.

CHAPTER IV.

GENERAL ACCOUNT OF THE SHEEP.

"The Lord is my shepherd; I shall not want. He maketh me to lie down in green pastures; he leadeth me beside the still waters."—Psalm xxiii. 1, 2.

We have now concluded our sketch of the various breeds of cattle; but so closely is the sheep connected with the ox that we have determined to give some little attention to that animal also. Indeed, when we came to deal with the diseases and disorders of oxen, we found it next to impossible to refrain from discussing those of the sheep, so nearly allied and so closely similar are they. Hence we hope, in the pages which follow, to supply our readers with the chief points regarding what is known concerning the pathology of the sheep—that docile animal which was so well tended and cared for by the patriarchs of the Old Testament history, and also by their descendants who, in later times, took delight in watching their flocks in Palestine by night. Indeed, so greatly prized was the sheep in those primitive times that that humble animal was compared by our Saviour to us human beings in like manner provided for by the Almighty. This love of the sheep, so characteristic of shepherds of all times and all nations, happily still exists in the hearts of many shepherds of this day.

In point of fact, there is great need for accurate information concerning the chief ailments to which sheep are liable to be subjected. Not only is it necessary for those who have to do with sheep to guard against actually fatal issues, but they should also strive to do all they can to avoid that weakening of the general system of sheep which is unfortunately far too

frequent; and although it may be observed that many of the risks and dangers rather point to the necessity of prevention than to that of cure, still a knowledge of the causes of loss and damage is of primary moment, not only in so far as it bears upon the question of prevention, but also inasmuch as it must and does facilitate acquisition of an acquaintance with good and reliable methods of treatment.

The subject now being entered upon has not as yet been thoroughly worked out. It is true that some of the most usual and best known disorders of sheep, such, for instance, as verminous bronchitis, sheep-rot, sheep-scab, small-pox of sheep (*variola ovina*), rheumatic arthritis (a disease which at times seems to assume a peculiar epizoötic form, the sheep hobbling about with swollen hock and knee-joints, from which a greenish fluid exudes if the joints are opened), braxy (in many cases identical with anthrax), the mild form of cattle plague which occurred in English sheep at the time of the grave outbreak among oxen in this country, foot-and-mouth disease of sheep, and other ovine diseases are fairly well understood by specialists. But there are other maladies with which the sheep is liable to be afflicted which are not yet perfectly comprehended in regard to their origin and the best means of prevention and cure. A great deal remains unknown, and it is of paramount importance that connections betwixt the diseases of sheep and those of other animals should be well and carefully learnt. With respect to the more common complaints, it may be said that they are very similar to those which occur in oxen, and that similar lines of treatment, but with much smaller doses, are often indicated. The digestive system being similarly constituted, and the sheep feeding on similar food, the derangements of the alimentary mechanism are also similar. For instance, should the rumen be found to be engorged, a skilful veterinary surgeon may perform the operation of rumenotomy in the sheep, as also in the case of the ox.

The sheep, like the ox, when debilitated, is, of course, very frequently consigned to the butcher, and hence the advice of the veterinarian in regard to what should be done must, as in the case of oxen, be always given with this alternative very clearly in view. Moreover the sheep, being necessarily a much less valuable animal than an ox, in the general way cannot be treated with the same degree of attention. It is very seldom that the

veterinarian is called upon to treat sheep individually, for only in the case of valuable breeding ewes or rams is it usually supposed to be worth while to do so. As a rule his advice is sought when a whole flock of sheep goes wrong, as frequently is the case. Sometimes a flock of sheep may suffer from verminous bronchitis, or they may be severely afflicted (especially lambs and young sheep) with intestinal tapeworms, and sometimes with divers other kinds of evils, *e. g.* those incident to ewes before or at the lambing season, and so forth. The gadfly of the sheep the *œstrus ovis,* is the source of terrible distress and torment.

That the sheep is liable to the attack of this fly, which deposits its eggs in the nostrils of the unfortunate animal attacked, was as well known in ancient as in modern times. Instinctively aware of the presence of this insidious and dreaded enemy, the sheep display the greatest terror at the sharp and menacing sound produced by the gadfly's wings as the insect sweeps through the air. They congregate together, placing their heads almost in contact with each other, snort, and paw the ground, and use all means in their power to prevent the fly from accomplishing its fell purpose. When a gadfly succeeds in attaining its aim, it rapidly deposits an egg or two in the nostril, and then leaves them there. The eggs are soon hatched, and the young larvæ crawl up the nostril towards the frontal sinus. There they remain until full grown, when they crawl through the nostrils, fall on the ground, burrow therein, and undergo their changes into the pupal and perfect stages.

Again, sheep-scab is a far more important disease in the case of the sheep than is scabies in other animals, on account of the damage it does to the fleece. When we come to the consideration of braxy, a name given to different diseases of sheep, one of which is anthrax, we shall have to point out that the carcases of sheep which have been afflicted with this latter malady should never be used for human food. Further, when we come to small-pox of sheep, we shall find that "the resemblance of this disease to human small-pox is very remarkable, both in symptoms, mode of communication, and rate of mortality" (Dr. Gregory) ; and also that it sheds some valuable light on the relations of that disease.

In nearly all cases of disease in sheep, both remedial and preventive measures have to be undertaken on a large scale. Some

of these we shall consider in due course. Now, however, we proceed to give a very brief account of the sheep, having gathered some valuable hints from the well-known work on "Bible Animals," by that deservedly popular and eminent writer the Rev. J. G. Wood.

The sheep has been domesticated from the very earliest times. In reading the Bible narrative we should recollect that the pasture-lands of the East are of very wide extent, very much more so than are the Downs and the Highlands, which in these days afford examples of the mode of sheep-keeping described in the Old Testament. Sir S. Baker, in his work on Abyssinia, depicts a state of things wherein the Arab herdsmen of to-day represent the Israelitish shepherds of old. The Arabs with their goats and sheep gathering round the wells recall the recollection how "Jacob went on his journey, and came into the land of the people of the East. And he looked, and behold a well in the field, and lo! there were three flocks of sheep lying by it," &c. In fact, the present Arab daily life in the Nubian deserts furnishes us with a picture of the past. In the days spoken of in the early Scriptures the necessity of obtaining water always occupied the shepherd's mind. We, living in this climate of England, can scarcely appreciate this anxiety with respect to the supply of water, and we must bear in mind that not only is there a scarcity of this needful fluid, but also that it is far more urgently required than it is in temperate and moist countries. It has been recorded that men have sat down and died of thirst, even when in sight of the river which, had they but possessed the strength to reach it, would have supplied them with the water by which their lives might have been saved. We read in the Bible narrative how Jacob, and how Moses two hundred years after him, performed for maidens tending their fathers' flocks the courteous office of drawing the water and pouring it into the sheep-troughs, and how they both married the girls to whose charge the flocks had been in each case entrusted. This brings us to the Oriental custom which has been preserved to the present day. The wells at which the cattle are watered at noon-day are the meeting-places of the tribe, and it is chiefly at the well that the young men and women meet each other. As each successive flock arrives at the well, the number of the people increases, and while the sheep and goats lie patiently around

the water waiting for the time when the last flock shall arrive and the stone be rolled from off the mouth of the well, the gossip of the tribe is discussed, and the young people have ample opportunity for the pleasing business of courtship.

"Passing his whole life with his flock the shepherd was identified with his sheep far more than is the case in this country. He knew all his sheep by sight; he called them all by their names, and they all knew him and recognised his voice. He did not drive them, but he led them, walking in their front, and they followed him. Sometimes he would play with them, pretending to run away while they pursued him, and consequently they looked upon him as their protector as well as their feeder, and were sure to follow wherever he led them." (J. G. Wood.)

The shepherds of these days know their sheep by sight; but they cannot teach the sheep to recognise their names, though this appears to be still done in Greece. Owing to the continual moving of the sheep, the shepherd had very hard work during the lambing time, and was obliged to carry in his arms the young lambs which were too feeble to accompany their parents, and to keep close to him those sheep which were expected soon to become mothers. At that time of year the shepherd might constantly be seen at the head of his flock, carrying one or two lambs in his arms, accompanied by their mothers. The dogs were not made the companions of man, as they now are among ourselves. Crouching together outside the strongly-built sheep-fold, in little knots of six or seven together, they detected the approach of wild animals, and at the first sign of the wolf or the jackal barked out a defiance, and scared away the invaders.

To the pastoral inhabitants of Palestine the sheep was, and indeed still is, one of the chief sources of food, just as the ox is to the pastoral inhabitants of South Africa. To ordinary persons, however, it was a luxury seldom tasted, being used, for instance, at marriage feasts or to welcome the advent of a guest for whom a young male lamb or kid was slain and cooked. Boiling was the method of cooking generally adopted. As all know who have tasted it, the milk of the ewe is very rich, and in the East it is valued far more highly than is that of the cow. It was, however, seldom drunk in the fresh state, but after it had become sour, curdled, and semi-solid. At the present day this custom still exists, the curdled milk being known under the

the name of "leben." Similarly, the Kafir tribes of South Africa also live largely on curdled milk, which goes by the name "amasi." The fresh milk is placed in a vessel which is never entirely emptied of already curdled milk, whereby rapid curdling is brought about. In England the milk of the sheep is scarcely ever used ; but in Scotland, especially in the great sheep-feeding districts, it is valued and specially employed for the making of cheese.

In the ancient times nearly the whole of the clothing was made of wool, and the wool would therefore be an article of great value, so that we are not surprised to find that when the King of Moab paid his tribute to the king of Israel it was carefully specified that the sheep should not be shorn. Spinning the wool was exclusively the task of the woman, as it was in this country up to quite a recent time—a custom pointed to in the use of the term "spinster." Sometimes the shepherds and others who lived in pastoral districts made for themselves coats of the skins of the sheep, with the wool still adhering to them. The custom extends to the present day, and even in many parts of Europe the sheepskin dress of the shepherds is a familiar sight to the traveller.

In our country we have done our best to produce a hornless breed of sheep, on the idea that the nutriment is better expended on the body and fleece ; bnt in the East the horns form an important commodity, and are valued in proportion to their size. The ram's horn was chiefly used as a vessel for carrying liquids such as oil. A wooden plug was driven tightly into the larger end, and often it was covered with raw hide, while a small part of the pointed end was cut off, and the aperture closed with a small stopper. The horn thus manipulated resembled the old powder-horns which were formerly much used in England, and are even now in vogue in Palestine and many other countries. Trumpets made of ram's horns were ordered by the Mosaic law to be sounded at certain times, and their notes formed an important part of the ritual (Joshua vi.). At the present day one such trumpet at least is found in every Jewish community, being kept by the man who has the privilege of blowing it.

No animal was used so frequently for sacrifice as the sheep, The young male lamb was usually selected for this purpose, an example of which is afforded by the sacrifice of the Paschal lamb,

the precursor and type of the "Lamb of God who taketh away the sins of the world."

Sheep are endowed with great powers of adaptation to different conditions of climate ; they are found in all parts of the world, and the management of them, of course, varies in accordance with the characters of the environment to which they are subjected. While existing in the wild or semi-wild state, they roam about hither and thither on open fields and plains, and exhibit a considerable amount of sagacity in regard to the selection of their food. One of the reasons why the sheep is a specially valuable animal is because it can be maintained without great difficulty even in situations where other animals could not find enough to live upon. Moreover, this useful creature gives a very good return for the food which it consumes, supplying us as it does with our woollen clothing as well as with mutton. The manipulation of its wool alone gives employment to thousands of artisans. Great credit is due to the breeders who by their enterprise and by the prolonged exercise of their unremitting skill and industry have brought about the production of our modern improved breeds of sheep. We may now give a few hints as to breeding of sheep. Before setting a flock, the characters of the soil, situation, and climate should be carefully considered, since such conditions to a large extent guide us in forming a decision as to what breed would produce the best return. Then we should select the most superior animals of the particular breed selected. It is said that "breeding in the line" is probably the best method, and that "crossing" and "breeding in and in" are not advisable. However, even when using the method spoken of as "breeding in the line," much depends upon the correct matching of the males and females, especially if they are chosen from different families, even though they belong to the same race but have been raised in other districts, and have consequently been influenced by climate soil, situation, and management. When using rams of the same flock, they should not be put together nearer than a third remove in the same line of blood. If this rule is departed from by putting together animals more closely related, it is very probable that disappointment will result ; but if the third removes are put together judiciously, first-rate animals may be produced.

It seems that particular kinds of wool are associated with certain kinds of mutton, and hence it is seen to be important that

those animals should be selected which possess both the best wool and the best mutton. The best wool is mellow, moderately long, thick, and bunchy, and under this kind the flesh is mellow and firm, and spreads more rapidly than any other. Extra firm or hard flesh is found under short and fine wool, but it does not expand in proportion. Sheep provided with thin-set and strong wool have white and objectionable heads, loose or coarse flesh which is also wanting in point of quality in proportion to the wool it bears. Consequently such animals do not spread out widely. It is preferable to select a strong ram from a well-bred flock belonging to the same family rather than to step out of "the line" to cross with a large sheep of an inferior breed. Experience of breeding proves that the produce of a large inferior sheep selected from a pure-bred flock is far better than that which results from a good-looking sheep chosen out of a cross-bred flock. The ewes should possess the larger frame, and, of course, the strength of breeding animals should always be very well kept up.

It is said that the "Leicesters," if mixed with the larger breeds, tend to correct their faults; but that the larger males, if put with the best Leicester ewes, do not give rise to improved offspring. Mountain breeds may be made larger by crossing; but the progeny will not prosper on the hill pastures of their dams, nor, indeed, on the pastures on which their sires thrive. In fact, they require intermediate situations; and we may add that it is well to bear in mind the general rule that it is always best to find the pasture which is suitable for the animal rather than to try to adapt an animal to a pasture which is not suited to its requirements. Lest it should appear that we are now insisting on a small point, we may say that so great is the effect of soil and climate, that when a group of animals has been equally divided and kept apart for twelve months upon two kinds of soil possessing opposite characters, the two sub-groups have, at the expiration of the year, scarcely resembled each other, when placed side by side, except in the shape and look of the head.

Some breeders hold that a good sheep should resemble the shape of a soda-water bottle; but others prefer that the upper and under lines should be parallel, and the sides together form an oval. If the sheep has the soda-water-bottle form, the animal has a thin neck, narrow hind-quarters, wide sides, or hanging

fore-flanks; it invariably stands on short fore-legs, walks with difficulty, and carries its head low. On the other hand, when the chines or shoulders are well thrown into the back, and the sheep has well-sprung top ribs and long hind-quarters, while the flesh and fat are evenly distributed, the animal stands well upon its fore-legs, and has an easy and graceful deportment.

If the pure breeds are crossed, good results may accrue. Furthermore, by judicious and repeated crossing, most valuable breeds may be established. Warmth is much more important in the case of sheep than is generally recognised. Owners of flocks ought to take great care that their sheep are fairly warm; but, at the same time, if they are kept at all under cover, there should always be a continual supply of good air. The ventilation ought to be well attended to. In selecting sheep for breeding, those provided with a wide and open chest ought to be chosen, whereas those animals whose chests are contracted should be avoided. Excessive feeding is to be guarded against. It is advisable to keep the sheep at an even temperature, so far as may be possible, and it is very wise to beware of clipping sheep at too early a date, for the sudden loss of wool is apt to be injurious. What the breeder should set before himself is to produce sheep which are at once symmetrical in form, robust, and docile.

After this brief introduction, we purpose to deal with all the diseases of the sheep, each in due course; and we hope to give our readers many practical hints from time to time.

At the present day a great deal of the management of the disorders of sheep is carried out by the shepherds, who give unremitting attention to their sheep, attention commonly beyond all praise, and recalling the beautiful and emphatic words and similes of Scripture. It is no unusual thing to hear that the shepherd has been up all night tending his sickly charges. His small stock of remedies is freely used. The resources of science are not at his command, and hence it happens that mistakes may be made. There are many fatal diseases (*e.g.* that called parturient septicæmia, which often makes such havoc among ewes at the lambing season) which are readily amenable to careful management if taken in hand in time, albeit that in this case, as in many others, prevention by means of isolation, antiseptic measures, care and cleanliness, must be looked upon as better than cure.

Our readers, of course, will readily understand that in regard to the disorders of sheep, as well as, indeed, to those of all kinds of animals, and even human beings also, there must always be very great difficulty in laying down hard and fast rules of treatment. In some instances a particular remedy may seem to be attended with marvellous results, and yet in another apparently similar case, when pursuing the same method of treatment, we may ignominiously fail. The inference to be drawn from this is that very great experience and judgment, combined with extreme care and wide fertility of resource, are alone sufficient to achieve great results in the cure of disease. Moreover, as our readers know, it is to be borne in mind that quite recently, together with renewed faith in therapeutic measures, there has, so to say, sprung up among scientific men a new era of management of disease, full of novel ideas and fertile with new appliances and methods. As is quite natural, we find that the diseases of sheep are not nearly so well known nor so well managed as those of mankind ; and there is no doubt that a great deal of the loss which annually occurs among sheep is avoidable, and that a great many deaths could be obviated by wise methods of cure.

CHAPTER V.

ON THE ORIGIN OF DISEASE AND THE GERM THEORY.*

JUST as on the sea-shore the many and varied sounds of the storm-tossed ocean, rolling onwards to the sandy beach, may be heard as one harmonious and magnificent monotone of a wild and yet moderated symphony; just as, too, the beholder, when he casts his eye upwards to the glorious dome of heaven, with its fleecy white clouds and its gloomy black clouds, and its myriad twinkling stars—o'er which the moon, "sweet regent of the sky," reigns in paramount serenity—gathers up into one grand picture this resplendent sight; just as other worlds around us play, with the earth whereon we live, mutually dependent parts; just as all things, though innumerable and infinite, yet partake of union and express a uniformity in Nature—so, too, do all things soever which come within the scope of human cognisance lend themselves, more or less completely, to simple and easily intelligible provisional modes of explanation.

The rules and the reasonings of common sense admit of almost indefinite expansion, and we find that the result of an extension of the universal law that every cause must have an effect, and inversely, that every effect must have had a cause, could we but trace it, does, as a matter of fact, lead us to that belief in evolution which, having previously been recognised in every other department of human inquiry, has at length also been admitted to hold, even in the last strongholds of empiricism, the domains held by the monsters Disease and Death. For some time it has been held that the Universe, together with all its multifarious contents, has gradually been developed from the simplest forms

* By ALBERT GRESSWELL, B.M., B.A., Christ Church, Oxford, M.R.C S.

of matter of a primeval past. The life-work of Charles Darwin, coupled with that of other writers and investigators, such as Herbert Spencer, added the link of vital phenomena to the chain of thought, which was previously incomplete. Now one more link has been hinted at, it is for the observers of this age to rivet it; and we must not forget that the difficulties which will be experienced by those who try to effect this will proceed rather from a superabundance than from any deficiency of the facts to be gathered together into one unique whole. Those who attempt to trace the idea of evolution throughout the mazes of Pathology will have before them a gigantic task, but yet one which most urgently requires to be fulfilled.

There are so many different points of view from which the subject can be regarded that one may be apt, while insisting upon one or other aspect, to lose sight of the rest. The great thing is that in our investigations we should never put out of mind the essentials of our pursuit, that we should never be content with having traced our subject backwards, until we have actually grasped the very root of the matter, so far as our human intelligence can enable us to do so. In this our humble attempt which follows we shall do our best to set forth clearly a few of the points which have struck us, and we only advance it as a primary sketch which we hope to be able to fill up more in detail at some future time.

Now, after this brief introduction, we may begin by repeating that the theory of evolution is nothing other than a perfection, or rather, perhaps, an amplification, of the ordinary human methods of reasoning, and, consequently, it will, of course, be applicable to all groups of facts when they are thoroughly understood. Granted that there must be in all things an unknown and unknowable factor, which we cannot discuss even cursorily in this connection, since it would draw us away much too far from our subject to do so, we must never rest content with any explanation of a thing or things until we have cleared the ground of every other ascertainable factor; and the degree to which we succeed in doing this will be a measure of the thoroughness of our investigations. To those who would object to the theory of evolution, that it is not complete, because it does not give a thoroughly intelligible explanation of the actual basis and reality of things, it is to be replied that it achieves the next best object

to this, viz. the highest provisional *rationale* which the mind of man has grasped. Indeed, it may be said to be a universal law of causation. Naturally it was first recognised where most easily perceived, and only in quite recent times has the idea of definite causation been traced into the sphere of vital actions, a sphere which necessarily was at first replete with doubt and mystery. In view of the mass of evidence now at our disposal, it may be said that although the theory does not always strike us as being in complete accord with all the observed and multifarious facts of life, yet, nevertheless, the closest examination of difficult points will invariably reveal that what aspects of life are involved in the folds of the inexplicable are certainly of no greater magnitude than are the other equally inscrutable mysteries presented by many of the inanimate aggregates existing in the universe. In other words, it may once for all be admitted that, so far as the need for explanation of their origin and existence is concerned, living beings cannot now be looked upon as offering greater difficulties than do the Heavenly bodies, for instance. No doubt at first sight the various processes displayed by living organisms are apparently more wonderful than are the other kinds of phenomena presented on all sides to our consciousness; but in proportion as by studious investigation we gradually become more and more familiar with life as displayed by the innumerable living things around us in earth, sea, and sky, the great question cannot but present itself whether the marvellously-regulated motions of the heavenly bodies, and even the bare existence of them throughout the starry spaces of the heavens, is in essential reality one whit less wonderful than is the conscious existence of any human being. In short, the systematic explanation of all things according to the idea of a gradual evolution of them, *i.e.* according to a universal law of causation, is a very great advance in our methods of reasoning on the erratic and confused conceptions which were formerly held in respect to the phenomena occurring around us. Furthermore, it must be sufficiently obvious that, since changes or functions displayed by organisms which depart so far from those of health as to be called abnormal, can only be classed as part and parcel of the sum total of processes manifested by them, they, too, can have no other than a similar relative explanation.

Hence it follows that the idea of evolution in the field of

pathology is in reality not only to be accepted in itself as unquestionably true, but is rather, as we hope to show, to be accounted as one of the supports of evolution at large. If it is true that the numerous and involved processes which make up healthy life in all its many varied forms and phases are to be considered in connection not only with one another, but also with the phenomema from time to time occurring in the outside world, it is also no less true that the general statement applies with just the same force to the facts of creatures suffering from disease, as it does to the normal functions of healthy living beings.

We hope that we may, in some degree at least, succeed in pointing out some few facts of disease which will bear out this statement, and also in attempting to indicate causation in some instances where at first sight even connection may not be easily traced. It is, however, sufficiently manifest that, though we can to a large extent say definitely of many given structures and functions that they are either normal or abnormal, as the case may be, there are instances in which it is extremely difficult to draw the line of demarcation, and it is quite evident that the same law of causation which we suppose to be applicable to the one group applies with equal force to the other. If a structure is disorganised, or a function vitiated or altered, there must always be a cause, could we but trace it, for the change which has resulted. The origin of the alteration may be ever so remote. We may possibly have to look back to a far distant point of time, to progenitors of a bygone age. Still the cause has existed in some form at some time.

Perhaps one of the most important of all the possible indications concerning pathology is that the various diseases and disorders which are liable to afflict human beings present relationships with those of lower animals, just as, indeed, other human characteristics, whether structural in nature or functional, are likewise related in certain ways to those of organisms lower in the scale of vitality. Even now the evidence which supports this generalisation is very strong indeed, although the science of pathology has as yet been only cursorily studied from the comparative point of view. As yet men have scarcely learned to fully realise the incalculable advantages capable of being derived from investigating the diseases of human beings by the

help of the light thrown upon them by the normal and abnormal processes presented by lower animals. Nevertheless, already it is the case that many talented pathologists are beginning to track out new paths leading to fertile regions, and now is the time for very many more earnest and zealous workers. There are, indeed, immense stores of knowledge to be gained, and many fruitful opportunities are available for all those investigators who are desirous of throwing more light on the many abstruse problems presented by disease. This present time is one of transition, and many of our ideas as to the processes of life, both well-ordered and disordered, will probably be ere long very essentially modified and changed. The mysteries of life, disease, and death, are now being marvellously cleared up. We are beginning to see things in their truer light, and to understand that gradual working, in accordance with necessary causation and connection is the *rationale* of *all* that goes on around us.

Now it is not too much to say that the idea that certain diseases are caused by the presence and growth of minute vegetable forms in the blood and tissues is one of the most important of all the generalisations which have ever been made in regard to the causation of diseases, and consequently also in reference to both the prevention and the cure of them. Hence we propose to introduce our discussion with a few words respecting this momentous discovery, and we would, while so doing, point out in passing, that, densely congregated together as human beings are in the innumerable towns and cities of the world, they are always liable to imbibe, both by the medium of the lungs and by that of the stomach, the various poisonous substances produced in the course of nature, and also the germs of the numerous diseases liable to be present. A new world of organisms, doubtless the causes of certain different diseases with which particular kinds of them are found associated, has been revealed to investigators by the help of modern microscopic methods. Hence we have been led to look upon the phenomena of zymotic diseases in particular, and also to some extent upon all the abnormal processes of animals generally, in some measure from this point of view. Now, men are gradually building up one true science of pathology and therapeutics, as explained by the simple yet all-embracing idea of a gradual origin of diseases. It has been clearly demonstrated that many diseases, as one

example of which anthrax may here be mentioned, are connected apparently by way of causation, with the presence of organisms of microscopic size in the blood, the lymphatics, and in the different parts of the tissues and organs. No doubt there are certain conditions of receptivity on the part of the human beings or the animals liable to be attacked by these germs, and although at present we know very little indeed definitely on this point, yet the information gathered in regard to these and allied questions, is gradually but surely growing, and already much has been learnt respecting the best methods of coping successfully with these living germs. Moreover, long and instructive as is the list of those diseases which have been shown to be dependent upon the entry of living germs into the blood, or upon the inroads made by them upon other fluids or structures of animals, we may safely infer that the continuance of searching investigation will lead to similar conclusions regarding the causation of other diseases not yet thus explained which affect human beings or lower animals or both. Further, it is important to note that while many of the maladies known to depend upon the presence of living vegetable organisms in the fluids or tissues, or both, are liable to afflict human beings, some are peculiar to lower animals, whereas others are alike capable of attacking both human beings and animals indiscriminately. In short, the relation betwixt the diseases of human beings on the one hand, and those which afflict animals on the other, is a close one, and one of the greatest significance. The diseases, and especially those of a contagious and infectious nature, such, for instance, as bovine scarlet fever, from which Mr. Power and Dr. Klein have shown that in all probability human scarlet fever is capable of being derived, are now attracting a very considerable amount of attention on the part of bacteriologists and comparative pathologists which cannot fail to affect very deeply all our ideas in regard to the various workings of disease. Of the numerous diseases which afflict human beings, some at least are liable to be communicated from lower animals, and consequently our knowledge, in order to be complete, must be supplemented by such information as can be derived from studying the origin of these particular maladies. The three dread diseases, known respectively under the names tuberculosis, anthrax, and rabies, seem to primarily attack lower animals, although they are also grave scourges to human beings,

and if to these we add scarlet fever we have a list of four. Now, tuberculosis is very widely prevalent among cattle, and also it occurs in fowls, and it is not improbable that this disease may be transmitted from infected oxen to human beings by the medium of the milk and by that of the flesh. Vendors of milk, therefore, ought to be prevented by severe repressive legislation from selling the milk of diseased cows. Indeed, it is quite as necessary that this precaution should be effectually carried out, as it is that the prohibition of the sale of flesh for human food that is unfit for that purpose should be duly enforced. Of late

Fig. 14.—From a Preparation of Human Tuberculous Sputum, stained after the Ehrlich-Wrigert method. The rod-like bodies are the tubercle bacilli (stained pink).—After *Klein.*

years great improvements have been made in relation to such questions as this which we are now considering, and the advances which have been made in hygienic science have highly conduced to the public health ; but we must not forget that though much has been done, nevertheless there still remains a great deal more to be achieved in the future at the hands of the various sanitary authorities. It is to be borne in mind in this connection that milk especially is, unless due care be taken, from several different causes, liable to be a source of danger and of death. Not only the germs of scarlet fever, but also those of diphtheria, those of typhoid fever, as well as probably those of many other maladies, may, through the agency of milk, spread desolation far and wide. These germs mav be conveyed to the

milk by means of the contact of that fluid with the exhalations of patients, or they may be communicated to it by the addition of water into which some infective excretion has been accidentally introduced in consequence of faulty drainage or other hygienic defects or shortcomings. The chief part of the danger is owing to the fact that milk is a liquid most admirably suited to the growth and multiplication of germs, so much so, in fact, that if only a few gain entrance into it, they very readily multiply, and this is, we may suppose, one of the chief reasons why milk is so liable to become a means of infection. Moreover, the source of the danger may be of a more direct kind even than this. It is true that in the case of tuberculosis we cannot be quite certain that human beings become infected with this disease as a result of the consumption of either the flesh or the milk of tuberculous oxen. However, with reference to the transmissibility of scarlet fever from oxen to human beings, the recent evidence supplied by Mr. Power and Drs. Klein and Cameron is well-nigh conclusive, and we may almost feel quite certain that one of the most fruitful sources of the dissemination of scarlet fever in our midst is the drinking of that most nutritious but yet at times most dangerous article of diet—milk. It has been proved that bovine animals may be affected with a disease apparently so mild in nature that it may merely be noticed as a slight eruption, but at the same time capable of spreading scarlet fever far and wide amongst unsuspecting families. Hence we cannot be too careful in regard to the selection of the milk we use, and it is in all cases a very wise precaution to raise the temperature of that fluid to just below boiling point, and to keep it at that temperature for some little time, since this is said to be sufficient to kill the streptococci of scarlet fever, if they be present therein. Moreover, the milk of one infected cow is sufficient to vitiate all the milk of a dairy, if it be mixed with that of others, for these vegetal germs will thrive and multiply rapidly, and a very few of them will soon lead to almost incredible swarms.

In reference to this most important topic we here insert the following hints culled from an able leader in *The Times* of December 6th, 1888 :—

A Report, by Professor Brown, C.B., on *Eruptive Diseases of the Teats and Udders in Cows, in Relation to Scarlet Fever in Man*, has recently been issued

by the Agricultural Department of the Privy Council. The report is an endeavour to minimise, as far as possible, the importance of the facts bearing upon the same question which were made known by the researches of Mr. Power, and were published in 1886 by the Medical Department of the Privy Council. In December 1885 a sudden and extensive outbreak of scarlet fever appeared to be associated with the distribution of milk by a retailer in Marylebone, and also to be limited to the area of distribution of that portion of his milk which he received from a particular farm at Hendon. It was elicited that the milk supplied from certain sheds at the Hendon farm could be specially connected with the outbreak, and also that outbreaks had occurred in various places at St. John's Wood, in St. Pancras, at Hampstead, and at Hendon, in connection with the movements from shed to shed of a particular cow, and with the distribution of the milk which was furnished by the cows occupying the shed in which she was placed. It was ultimately discovered that a certain cow had been bought at Derby market, forthwith brought to London, and transferred on the following day to Hendon dairy. She was suffering from an eruptive disease affecting her udders, and she is said to have communicated this to other cows with which she came into contact. As the disease spread in the dairy the original definiteness of the distribution of scarlet fever by the medium of the milk supplied from the sheds which the Derby cow from time to time inhabited became less and less distinct; and it soon came about that suspicion attached itself to all the cows which had contracted the same malady. These were accordingly put together into one shed, and it was decided that the milk yielded by them should not be sold, but given to pigs. This decision having become known in the vicinity, certain poor women resident there prevailed upon people employed in the dairy to neglect the order and to give the milk to them, with the result that their families were stricken down by scarlet fever of peculiar severity. The assistance of Dr. Klein was then solicited, and this talented observer succeeded in obtaing a definite microbe (a streptococcus) from the infecting milk, and by inoculating calves with cultivations of this streptococcus he produced in them disease of a fatal character, which was attended by organic changes resembling those of scarlet fever.

Professor Brown seems to assume that he has supplied the true cause by asserting that a man who lived within a mile of the dairy in question had a daughter who was attacked by scarlet fever, and a son who made it his amusement to visit the dairy as often as possible. It is not suggested that the son had scarlet fever at any time, but the fact that his sister had the disease at the time that he was going to and fro is mentioned as a possible explanation of a milk epidemic of wide diffusion and considerable severity. Professor Crookshank's researches on this occasion seem to have been directed to prove that the microbe found by Dr. Klein was the streptococcus pyogenes, one to which the Professor attributes the power of producing a great variety of morbid conditions.

On the whole it certainly seems that the case made out by Mr. Power has not in any important particular been shaken by the Report. Professor Brown, indeed, lays much stress upon negative evidence—upon the fact that there does not appear to have been any general correspondence between sore teats in cows and outbreaks of scarlet fever in mankind; and he scarcely seems to give due weight to the fact that there may be very different forms of sore teats—a question which requires the most searching investigation.

However, Professor Brown perhaps does well to caution us, inasmuch as, though we cannot accept his rather optimistic views, still his very opposition or hesitancy must assuredly help the cause of scientific truth, since it will

doubtless bring forth still more research, and our readers will be eager to watch for the results of renewed and prolonged investigation. For our own part we believe Mr. Power's and Dr. Klein's work is thoroughly established, and we must here again insist upon the advantage of having all milk boiled before consumption, since this precaution will, there is good reason to believe, insure absolute safety against all the ordinary contagions of which milk may be the carrier; and, as we do not consume other kinds of animal food without cookery, there is nothing remarkable in cooking milk as well as flesh. There is, moreover, one point of Professor Brown's report with which we are in complete accord—that, namely, in which he refers to the filthiness of many dairies, and the necessity which exists for the precautions which are voluntarily taken by some milk-sellers being enforced by law upon those by whom they are as yet neglected.

Now, in reference to anthrax, more usually known when afflicting human beings as woolsorters' disease or as malignant pustule, it is well known that rod-like bodies swarm in the blood

FIG. 15.—HEART'S BLOOD OF A MOUSE DEAD OF ANTHRAX. 1. Blood Discs. 2. White blood-corpuscle. 3. Bacilli anthracis. Magnifying power 700. (Fresh specimen.)—After *Klein*.

of sufferers from this dreadful scourge, whether they be animals or human beings. The different varieties of micro-organisms require various definite conditions for their growth, development, and multiplication. In very many cases damp and wet are associated with putrefactive changes, that is, with the decay of lifeless organic material, both vegetal and animal. This putrefaction or decay really depends upon the vital processes of certain micro-organisms. It is, moreover, by no means difficult to see how an animal, already suffering and debilitated in consequence of the more direct results of damp and cold, and partially famished owing to the lack of nutrient material, may readily fall a prey to the insidious attacks of these minute and rapidly-multiplying organisms. They may enter the body by means of the lungs or the alimentary canal or may gain access to the blood through

contact with an abraded surface. In the course of ages particular kinds of schizomycetes, among which bacteria are included—these are the names by which these germs are known—would gradually tend to become more dangerous than others in the case of some of the various groups of animals respectively. It is quite probable that one kind of germ would become particularly harmful for one kind of animal and another more especially dangerous in the case of another group, and so on. It may possibly be the case that germs which were once merely putrefactive organisms gradually found entrance into the bodies of animals,

Fig. 16.—From a Preparation of the Blood of the Spleen of a Guinea-Pig dead of Anthrax. 1. White blood-corpuscle. 2. Red blood-discs shrunken. 3. Chains of bacillus anthracis. 4 Degenerating bacilli, the sheath only being preserved. Magnifying power 700. (The preparation had been stained with gentian-violet.)—*Klein.*

thus becoming pathogenic and often giving rise to fatal diseases. In some such way as this we may suppose that certain diseases originally arose. The life-history of septic micro-organisms outside the animal body is not well known as yet. The facts that they are modifiable by alterations of temperature and by differences in the medium to which they are subjected, supply us with clues which are being extensively worked out. There are, for instance, some bacteria which, under the influence of certain conditions of this kind, produce definite pigments. From the results of his many experiments, Dr. Klein concludes that there are some definite micro-organisms which, as a rule, exist and grow in various substances, and also

possess the power of growing and thriving in the bodies of certain suitable animals, in them producing a definite pathological condition.

"Just as there are species of plants which act as poisons to the animal body, and other species of plants which, although belonging to the same group and family, and although very much alike to the others, have no such power, and cannot acquire such power by any means, so there are micro-organisms which are pathogenic while others are harmless."—*Klein.*

The latter remain harmless, no matter under what conditions and for how long a time they grow. Further, it is most probable that careful and thorough drainage and the removal of all tendencies to wet and putrefaction must gradually bring about a gradual diminution of plagues, at least, such as are similar in their nature to anthrax. Other diseases also, such as ague and other malarial fevers, are occasioned by the prevalence of germ-containing vapours arising from ill-drained marshy lands on which the vegetation is always liable to undergo putrefactive change. Having briefly alluded to the germ-theory of disease, and having attempted to indicate the kind of way in which some diseases may have first originated, we now proceed to discuss other aspects of our present subject.

When dealing with the phenomena displayed by higher animals, we must remember that they, the animals, may all be considered as being composed of innumerable cells, or structures more or less closely resembling cells. A cell is a minute and generally microscopic body consisting of living matter called protoplasm or bioplasm, and containing in its interior an independent rounded body, also living, and called a nucleus. These cells have been modified in all kinds of ways and degrees, in correspondence with, and, so to say, in order to meet the many different requirements of more complex conditions. True, we cannot entirely explain the ways in which such effects are brought about, but we can very appreciably lessen the difficulties which most gravely impress us. The higher and more perfect an organism is, the more intimate is the combination of the many parts of which it is made up. These parts are united in various ways, and when thus united they are, moreover, still more wonderfully blended by connecting links of different kinds. Hence it comes about that in our attempts to explain the processes of life, whether normal or abnormal, we must bear in

mind that there is always a tendency for the constituent portions of higher organisms to dispense, in a greater or less degree, with the bonds which combine them, however well knit together the different parts may be.

Furthermore, there is the still greater danger always to be apprehended that these bonds themselves, among which the most important are the vascular and the nervous mechanisms, may be more or less completely rent asunder in any particular part, or in many different ways interfered with in regard to their efficiency. With these few words by way of prelude to the considerations which follow, we now propose to give an account, firstly, of some structural points bearing upon the question of evolution in disease, after which we shall discuss some functional aspects of that subject, and then conclude with a brief reconsideration of the more general points of view. Before continuing, however, I must here acknowledge the copious use of a work written some time ago by my brother, Dr. D. Astley Gresswell.

We now proceed to discuss "Some abnormal Structural Manifestations which point to the idea of Evolution."

Speaking generally, it is, as a matter of fact, found that by various plants and animals most of the substances known as carbo-hydrates, *i.e.* starches and sugars, are convertible into one another, that fats and some of the carbo-hydrates are mutually convertible, and that albuminates, such as white of egg, can be split up into fats and other bodies. Among lowly-developed creatures albuminous infiltration is general, and it also occurs in higher organisms. Albuminous infiltration, fatty infiltration, and fatty and pigmentary degeneration manifest themselves in lower organisms, and are also seen in higher organisms, both as phases of nutrition and, moreover, also as abnormal or reversional phenomena.

Glancing for a brief space at the lowest forms of life which are known to us, we observe that they multiply either by splitting into two or more independent parts, or by a very closely allied process, viz. the budding-off of portions which gradually increase in size, both before and after they are set free. Regeneration seems to be the more active the younger the individual, and also the lower in the scale of life it may be. It is said that the ova of higher animals may divide, and that

each of the two parts may, in the due course of time, develop into a perfectly-formed adult. With regard to the process of budding or gemmation above referred to, it may take place in any part of a lowly-developed organism; but, as we advance gradually up the scale of life, we find that it is only certain parts which can take on themselves this function of reproduction. Nevertheless, indications of the primary condition are manifested by such facts as that an arthropod can throw off a leg at the joint above a lacerated segment, and then bud out a new limb from the centre of the stump. Similarly also the newt, it is said, can replace an eye. It seems also very possible that the granulations which tend to occur on cut surfaces, the papillomata and other growths which make their appearance on irritated patches of the skin or mucous membranes, the villi of the chorion and their abnormal developments, are in reality expressions of a power or property of cells similar to that of fission and gemmation as displayed by the lowest organisms.

Moreover, growth and multiplication are enhanced by stimulating, or giving an extra supply of food to, the lower living things. Further, the same fact shows itself in the case of endothelium when made to germinate by means of stimulation and also, according to Kremansky, in that of the cells which are contained in the capsules of cartilage subjected to cauterisation.

Again, Stricker holds that every living cell of any higher animal may divide, and similarly Dr. Beale maintains that pus-cells may develop from bioplasm of any part of the body if too freely supplied with pabulum. When such processes as these we are speaking of manifest themselves on a large scale in higher animals, we speak of them as inflammatory; but, as a matter of fact, they are comparable in their essential characters with those which may from time to time occur among individual lower organisms. Certain of the processes, called inflammatory, even though they occur in the avascular structures of higher animals, are in reality the result of greater nutritive activity, and are represented among living things by the rapid growth we have spoken of above. In support of this statement, it may be mentioned that the cells which result from inflammation are certainly fitted for but little more than the preservation of their own independent vitality, thereby affording

a striking similarity to the two or more cells produced by the division of a lowly-developed organism, each part of which is no sooner set free than it proceeds to go, so to say, adrift, about its own business, intent upon carrying out merely the objects and pursuits of its own independent life. In inflammation properly so-called, as it shows itself in higher animals, the simple process here spoken of is complicated with other factors. The migratory cells are even still more active, and stoppage of the circulation and the consequent accumulation of leucocytes and ozone-bearing corpuscles are prominent features of the process.

Now another step in pathological products which we have to consider is one in which the growth and multiplication of cells, instead of being merely transitory phenomena, establish themselves, more or less persistently, in a permanent form. It may briefly and unhesitatingly be said that all new formations, as instances of which the enchondromata may be here mentioned, are markedly characterised by the preponderance of cellular elements modified in various ways and degrees.

They may fibrillate and may even become calcified, but very rarely, if ever, do they develop into the highest forms of tissue, the muscular or nervous. Of course this is what we might expect, since it is clear that the tissues of most important specialisation must necessarily be produced, so to say, with greatest difficulty.

Speaking generally, we may say that all the tissues of all organisms, both low and high, have been proved to be so much like the modified results of primitive cells, more or less closely blended together, that we may suppose them in all cases to have arisen, directly or indirectly, from cells in the first instance. We have now, however, to add this further fact above mentioned, viz. that those growths which are spoken of in pathological language as new formations are also indubitably traceable to the growth and proliferation of the same units, cells, or, at any rate, cytodes, *i.e.* cells without the nucleus. Together with this, we must also bear in mind the additional statement likewise above made, viz. that the cells may be modified in various ways and degrees, or, indeed, on the other hand, so little changed as to be scarcely distinguishable from those parent cells which originally gave them birth. In short, new formations clearly point to a

remote ancestral condition when the primary importance of cells as units, distinct and not combined, was very much greater than it can be in higher organisms in which each constituent cell is most intimately dependent upon the activities of the other cellular units with which it is so intimately co-ordinated. Among the different kinds of new formations the enchondromata most pointedly illustrate the reversional ·characters of which we are speaking.

Enchondroma myxomatodes exhibits characters like those of the notochord found in all vertebrata, and also in some invertebrata. The cells, moreover, of some enchondromata are stellate, their processes uniting to form a network, and in the Selachii, the root-forms of the vertebrata, similar cells are present. Again, these enchondromata are most usually found in the limbs, and especially in the distal parts of the limbs. Now the primary condition of the vertebrate limb is seen in the Selachii, among which animals the limb is composed of a great number of cartilaginous rods, which are arranged definitely, and increase in number towards the distal extremity of the pro-pterygium, the meso-pterygium, and the meta-pterygium. It certainly appears possible that the enchondromata situated in homologous parts may, so to say, point backwards to the ancestral condition of the limb. Corroboration of this statement is seen in the frequency with which cartilaginous bodies develop in connection with certain joints of the limbs in man and animals. These cartilaginous nodules may be either single or multiple, and some may be as large as a small apple. Cruveilhier figures several round cartilaginous bodies as occurring in an elbow-joint, and it has also been observed that cartilage cells have been found in the synovial tufts of some joints. Similarly, Mr. T. Smith removed over 250 loose rounded cartilages from the knee-joint of a man on December 13th, 1882, at St. Bartholomew's Hospital. He also operated on a woman whose case has been recorded by Mr. Harrison Cripps, in *The Transactions of the Pathological Society of London*, vol. xxvi. This woman, aged twenty-eight, had for six years, in the upper third of the right arm, immediately beneath the skin, a pyriform tumour which was 3½ inches long, and 2 inches in diameter at its thickest part, and tapered towards the axilla. Within its capsule were found one large mass of cartilage, and twelve or

more detached lobulated bits of cartilage. Moreover, in the axilla there were also similar detached nodules of cartilage.

The cases of supra-scapular developments brought before the Royal Medical and Chirurgical Society of London by Mr. Willett and Mr. Walsham were also similarly regarded. Supernumerary fingers, too, have been supposed to point backwards to the many-rayed Selachian fin.

Again, new formations of capillary vessels are as a rule congenital, and they are also much more generally met with in the skin of the head and neck than elsewhere. These two facts may suggest the possibility that they are in some degree homologous with the vessels which develop about the epiblastic involutions lining the visceral arches of the lower vertebrata. In support of this idea it may be remarked that Dr. D. A. Gresswell recently observed in a patient a nœvus which extended in a snake-like manner down the right side of the neck. The nœvus was distinctly raised, and, tapering towards its upper extremity, it passed down the external auditory meatus for some distance.

Having considered some of the indications seen among some abnormal structural phenomena of higher animals which remind us of remote ancestral conditions, we now, in pursuance of the same line of argument, proceed to consider some special facts connected with the early division of the cells which make up the developing embryo of a higher animal into the three separate divisions known as the embryonic layers.

The lowest living beings consist simply of undifferentiated protoplasm, almost identical throughout, both in regard to form and in regard to functional capacity. The next stage in animal life is that which is represented by the Diploblastica, in which there are two distinct layers of protoplasmic units, either of which is in some measure capable of discharging the functions of the other. A third stage is that displayed by the Triploblastica, in which each of the three layers is largely independent, both in regard to structure and in regard to function, and is by no means capable of taking on the functions of another layer.

Similarly, stages comparable to these are passed through in the early development of the embryo of any higher animal, the three layers being known respectively as the epiblast, the mesoblast, and the hypoblast. Now, the resemblance which attaches itself to those parts of higher animals which have been developed from the

epiblast is seen in many ways. For instance, some mammals develop hair within the mouth, and the majority of the members of this class of animals are provided with a few hairs within the nose, and also within the external auditory meatus of the ear, and some also on the conjunctiva of the eye. Moreover, it is well known that the Selachii show, in the clearest manner, steps of transition betwixt scales on the skin on the one hand, and teeth in the mouth on the other, and it is to be remarked that both scales and teeth are limited to regions which have developed from the epiblast. Horny teeth occur in the stomachs of certain animals. Again, the occurrence of hair all over the body, with the exception of the palms and soles—an exception which is what we should expect on account of the friction to which these parts are constantly subjected—has been noted both in man and in woman.

The rashes of the specific fevers, too, sometimes illustrate the similar origin of the parts which they affect. For instance, the rash of scarlet fever may occur in any part of the skin, and even on the face, though its early punctate character may be rapidly obscured owing to the fact that the skin of the face is naturally very full of blood. The rash occurs also on the scalp, on the oral and faucial mucous membranes, probably also on the nasal mucous membrane as is evidenced by the constant thick stream of discharge so frequently seen flowing from both nostrils in infants and children, also on the conjunctiva, in the external auditory meatus of the ear, probably also in the middle ear and Eustachian tube. These latter points lead us to the recollection that the mucous membranes of the fauces, Eustachian tube, middle ear, and external ear are derived from the lining of one cleft—the Tympano-Eustachian cleft, the representative of the permanently open spiracle of the Selachii.

Similar observations are to be made in regard to the two diseases, measles and small-pox. Again, in reference to the drugs, belladonna and jaborandi, we know that belladonna causes dryness of all parts of the skin, including the mammary involution, and also of all parts of the mouth and throat, while jaborandi does the reverse of this.

Similarly, a sufferer from rheumatic fever has a moist tongue and an especially moist skin, and a phthisical patient also generally has a moist tongue and skin.

Again, it seems very possible that the comparative frequency of hair-bearing cysts in the brain and in the ovaries points to the original development of those structures.

In turning now to a consideration of the erect posture, we find many points of supreme interest and value bearing upon our topic.

Before it can stand erect, the newly-born babe is only capable of crawling as a means of progression, and for some time after its birth the relation of its head and legs to its trunk is similar to that presented by a lower animal. At a comparatively early age the child begins to bear with all its weight upon its legs, and this fact serves in some degree to explain the greater frequency of knock-knee and bowed leg in human beings as compared with animals. Among vertebrates the erect posture is maintained in the more highly differentiated, and it may be supposed that remote progenitors of animals which are now erect were prone. It is clear that the lower surface of a prone animal corresponds to the front surface of an erect animal. The ventral or abdominal surface, which in a prone animal is in relation with the earth, comes to be, in the case of an erect animal, in relation with space. Herein a great alteration in the supply and loss of heat is involved. To the prone the earth affords a protection from excessive radiation. This is illustrated by the fact that rabbits, when placed in the supine position, die of refrigeration.

Again, it is manifest that the abdominal contents of an erect animal tend, in case their supporting tissues should yield, to press upon the pelvic and inguinal structures, while it is equally clear that in prone animals the pressure is directed downwards and also perhaps forwards, in accordance with the slope of the ventral wall of the abdomen. Hence the fact that femoral, scrotal, and obturator, herniæ, are rare in animals as compared with man, while diaphragmatic and umbilical herniæ are equally common, if not even more so.

The rudimentary condition of the vertebræ of the tail—coming as they do after those called sacral, which support the pelvic girdle—has apparently special reference to the erect posture. There is no doubt that a bulky tail, or even a small one, could not but embarrass the action of the legs of an erect animal. Many arboreal animals assume the erect posture, and yet possess tails; but in them the tail is used as a prehensile

organ. The anthropoid apes, moreover, have the tail only poorly developed. Again, the shape of the rudimentary tail changes as prone animals become erect, in such a manner that it serves in some degree to support the pelvic structures.

In the hind limbs of quadrupeds the circulation of the blood is feebler than in the fore limbs. Possibly the erect posture in man may still further impede the circulation of blood in the lower limbs. Hence, we may explain the frequency with which gouty deposition in man generally first occurs where the circulation is most sluggish.

Furthermore the erect posture affords a freer play to the movements of the fore extremities. The late Dr. Rolleston used to teach that this additional freedom had removed the necessity for the continuance of the development of the panniculus carnosus, which muscle is useful in ridding the skin of some parasites, also in certain defensive and offensive operations, as for instance in the erection of the spines of the Diodon, the scales of serpents, and of the Manis, the quills of the porcupine, and the bristles of the hedgehog. Human beings, however, in virtue of their erect posture, possess so much more freedom of movement of the fore extremities than have prone animals, that this muscle has atrophied in them as a result of falling out of use. The fact that man has remnants of this muscle in the platysma myoides and, according to Henle, in several muscles of the head, is to be considered in relation with the fact that hairs still flourish on the head, the face, and upper part of the neck. Birds, however, are erect, and yet some have a remarkably well developed panniculus carnosus. An albatross was found by Dr. D. Astley Gresswell to have large tendons inserted into its feathers and into its skin. It is, however, very clear that in birds the fore limbs are specialised for flight; their freedom of movement in other directions being consequently correspondingly curtailed.

Man is right-handed, as indeed also are quadrupeds, though to a far less extent. In human beings, the fore limbs, being much freer than in animals, have acquired far greater independence of action. The fact that the right limbs have taken on the more complex tasks is attributed to the left side of the brain receiving a more direct supply of blood, and this view is strengthened by noting the frequency with which embolism occurs on the left side of the brain, as compared with its less

general occurrence on the right side, just as, similarly, the greater frequency with which embolism manifests itself in the left kidney as compared with the right kidney is attributable to the more direct course of blood to the former.

In short, numerous connections are to be traced among the phenomena of the diseases and disorders of animals which point unmistakably to a gradual development. How very important it is that such connections should be traced will be readily seen.

We now come in due course to another division of our subject, namely to that of some "Abnormal Functional Manifestations of Evolution."

The functions of an organism, or of the whole aggregate of organisms, no less than the structures of an organism or of the whole aggregate of organisms, are most intimately connected one with another.

Indeed the mutual interdependence of functions is almost universally admitted. The assertion that the various processes of change going on in a higher animal, that is, its functions have been evolved in association with one another, has been amply supported both inductively and deductively. The phrase "associated functions," like the corresponding idea of "correlated structures" expresses a great and undeniable truth.

A canary, when building in captivity, may be seen to fly about its cage with the straw before placing it in position, that is to say, it unnecessarily attempts to do, under altered circumstances, things which canaries, when making their nests under the ordinary conditions of nature, are actually compelled to do. Though, then, in new circumstances, both animals and man acquire new habits, still, in many cases, relics of the old ones remain. Those functions which will persist for the longest time are those which have, by any means whatsoever, been most strongly impressed upon the organism or upon its progenitors.

If we examine carefully all the numerous processes undergone by animals, we shall see that they may roughly be divided into two sets, viz. those of work and those of rest. It is quite true that these two sets are not entirely distinct, but rather they are intimately connected together somewhat in a similar manner to that which links together heat and cold, or light and darkness.

We shall find it convenient to speak of the one group of functions as the associates of work, and of the other as the

associates of rest, and we shall hope to show that when some of the associates of work are decisively manifested, there will be a tendency for others to appear; and similarly in the case of the phenomena of rest, these, too, are manifested to a great extent in association with one another.

The one great aggregate of processes is evoked when the organism must obtain food, effect its escape from pursuers, or fight an opponent, when, in short, it must exert itself to the utmost in measures of self-preservation of a direct and active character. The other great division of functions is exemplified when these objects have been met, when the end has been achieved for the time being, or when the mechanism of activity concerned in work needs rehabilitation and repair. These two well-marked associations of work and rest, developed in the healthy animal for the ordinary purposes of life, make their appearance also in the field of disease. When thus manifested, certain correlated processes of the one kind or of the other may in some cases work for good. Probably they may more frequently be productive of harm, while in some, unless they be checked, they may actually kill. The organic functions which make up the state of excitement are in reality processes of work, of activity. The effects of irritation, howsoever produced, those of pain, of joy, of fear, of any impulse to movement of whatever kind, are in some degree similar one to another. In disease we find phenomena corresponding in some measure with those of the chase and the fight, with the defensive measures adopted in cases of fear and so on, and even death may result from excessive and unequilibrated actions of the vital mechanism, as in extreme fear and intense pain. While certain associated processes may have been, and may still be, of the greatest benefit under certain conditions, they may none the less work great harm, so far as the individual is concerned, under certain other allied conditions. Thus a reaction, of inestimable value under certain conditions, may be one which under other allied conditions can not only serve no useful purpose, so far as we can see, but may even impede or retard recovery to a very considerable extent, and so bring about even a fatal issue.

Turning now to another but an allied point of view, we remark that the phenomena which constitute day, like those which make up night, have likewise in each case been co-existent for

immense periods of time. Moreover, it is to be remarked that the associates of work have alternated with the associates of rest to a large extent in the same way as day has alternated with night, and on a larger scale to some extent as summer with winter. Consequently we shall not be surprised to find later on that the rhythm of surrounding conditions has left its impress on the organic rhythm.

The Phenomena or Associates of Work.—An animal at work has an acceleration of pulse and respirations, displays excitement, increase of perspiration and of fecal discharge, and augmentation of metabolism and of the temperature of the body. Now there certainly is evidence to show that, if some of these be aroused there is a tendency for others, or of all, to be also aroused. If the temperature of an animal be artificially raised, the pulse and the respirations are accelerated, and the cutaneous glands are more active. The converse is the case if the temperature be reduced. A muscle, while contracting, rises in temperature, and there seems to be a very considerable total increase of heat in the body during action. Again, together with action, with excitement and with alarm, provided it be not too great, there is also associated an acceleration of the pulse.

In cases of exophthalmic goitre the heart beats more frequently, the action of the cutaneous glands is increased, there is a manifestation of restlessness, the bowels are generally freely open although the patient be confined to bed, the peripheral temperature is elevated, and at times also the oral temperature. These are the associated phenomena of work. Dr. D. A. Gresswell made daily observations for thirty-three days in regard to a woman aged 32 years, suffering from this condition, under the care of Dr. Southey, at St. Bartholomew's Hospital. Her pulse was always above 110, even when she was asleep. Her respirations were always above 22. The bowels were very freely open every day, on an average two to four times. The daily discharge of urine averaged fifty-two fluid ounces, varying, however, from forty to eighty fluid ounces. She slept fairly when sedatives were administered, but otherwise she was restless. The skin was at all times warm and moist, and the tongue also was always moist. The appetite was always excellent. The oral temperature was generally normal; but it rose at times to about 100 deg. F., and the palmar temperature was generally nearly as high as the oral.

Several other diseases, also, in which the heart's action is accelerated, illustrate the same points. Looseness of the bowels is often seen in children at the outset of scarlet fever, small-pox, and measles, and where Dr. D. A. Gresswell, who has had wide experience in fevers, has seen cases of typhus fever from the very outset, the bowels have been loose for a day or two. The same observer has recorded facts to show that the total bodily heat is greatly increased when human beings enter the tropics, and that the increase is greater in children than in adults; and, moreover, that an increase in the intensity of light brings on an acceleration of the pulse, most especially in the young.

Now diarrhœa is also apt to come on on entering the tropics, and especially in the case of children. Summer diarrhœa, too, may be due to various causes; but of these probably an increase of external light and heat acting directly upon the organism may be of much importance. Adults also very frequently have looseness of the bowels when entering the tropics. Hence, together with rise of external temperature and increase of intensity of light, there are exhibited rise of body temperature, acceleration of pulse and respirations, increased action of the skin and diarrhœa. In fact the associates of work are displayed. The different processes involved in work have, it seems, been evolved in such intimate connection that, when one of them is excited, the others also tend to manifest themselves.

With regard to acceleration of the pulse in the tropics, it is to be said that Dr. D. A. Gresswell's observations on a large number of persons while passing from temperate through tropical latitudes, on four different occasions, show that there is an acceleration of the pulse in the tropics under all ordinary circumstances. The pulse may, however, be slower in a tropical latitude when compared with that in a colder latitude, if the body be recumbent; but this is possibly due to a weak condition of the heart brought about by previous excessive action.

On the other hand, it is to be noted that a child's temperature will rise during constipation and fall when the bowels are relieved, and also that the temperature of a typhoid patient may rise during the convalescent stage owing to constipation, and fall after an action of the bowels, induced, it may be, by the administration of castor-oil, or other means. In these and

similar cases, the fecal accumulation excites the mucous membranes and the muscular coat of the intestines, and the additional activity brings with it, according to the view above expressed, a rise of temperature, and other associates of work. When, however, the bowels are relieved, this stimulation is no longer kept up, and the result is that the temperature falls.

The ready response of the temperature of a child or of a patient convalescing from febrile conditions to changed circumstances is well known.

Again, the action of some chemical compounds serves to illustrate the association of vital processes above mentioned. For instance, the administration of nicotine produces acceleration of the heart's action, perspiration, and diarrhœa, while morphine, on the other hand, causes a slowing of the pulse, a dry skin, constipation, and sleep.

It may very readily be seen that the associates of rest are the counterparts of those of work; but we must not forget that a state of rest may vary from that of simple repose to the pronounced rest of sleep, or hibernation. Now it is well known that if a man or an animal abstains from taking physical exercise, constipation very often results; and it is also to be noted that if one or more of the associates of work are kept in action, sleep is not to be obtained. For example, when too hot or greatly excited from any cause, we cannot sleep.

As we have pointed out above, there is apparently an association of certain vital processes, which are concerned in action, so that if one, or *a fortiori*, if more than one, be aroused, the others are generally also induced. There is also another association of vital processes called rest, and if some of these are exhibited, then, in the general way, the others will also be more or less strongly apparent. If we compare these two, work and rest, together, we meet with many striking points. Further, if muscles are freely exercised, they may become hypertrophied; while, if excessive rest be allowed, they become atrophied. This same rule applies also to other tissues and organs. The two states, rest and work, ought to be alternated with each other. It is most important that this rhythm of waste and repair should be attended to, for otherwise the muscle, the limb, or the organism, as the case may be, must suffer when waste exceeds repair.

Again, if we compare together day and night, we find that the day-time is characterised by the presence of sun-light and of sun-heat, and that in the day-time there have been manifested by animals for untold ages the associates of work. The pulse and respirations are more frequent in the day-time, and there is a separation of a greater amount of carbonic-acid gas and urea. The body temperature also is higher. It has been shown by Dr. D. A. Gresswell that light stimulates the action of the heart, and that tropical heat is accompanied by rise of the temperature of the body. The factors, then, which constitute day, external or inorganic, and internal or organic, are each and all concerned in adding to the activity of vital processes. The external factors (light and heat), in reference to the internal factors, stand, of course, in the relation of cause to effect, not only directly, but also indirectly, since they afford opportunities for working which are not present at night.

In short, a rhythm has thus been established in organisms in regard to day and night, and this rhythm is, moreover, still kept up, even when some of the factors concerned in the causation of it are altered, just as also the variations in the frequency of the pulse which have reference to meal-times persist, even if we pass the whole day without food. For example, if we commence working by night and resting during the day, it is some time before we obtain a reversal of the temperature curve, and the reversal is probably never quite complete. If, on the other hand, we proceed gradually from one meridian to the antipodal meridian, we gradually change all the associated factors of what was our day for those of night, and under those circumstances the daily curve of body temperature persists, although there are facts which tend to show that the older-established rhythm does not yield with the very best grace. Moreover, in pyrexial conditions the body temperature tends to rise and to fall at the same times as it does in health. Again, the fact that pain is so generally more intense by night than it is during the day, and the greater likelihood of a febrile patient being restless and afterwards delirious by night than by day, though the temperature be no higher, may be compared with the fact that in health, when hot during the night, we cannot sleep; while we may, even when hotter, be able to sleep by day. Day

being the time for action, the febrile temperature is therefore more easily borne at that time than it is during the night.

The division of time into months has reference to the phases of the moon. It has been suggested by Darwin that menstruation points to an ancestral time when spring-tides brought an extra supply of food. The fact that delivery occurs usually at the time of a menstrual epoch, and the times at which antepartum hæmorrhage occurs, may likewise be thus referred to bygone external agencies.

Next we come to the rhythm presented by the different seasons. Now it is clear that summer and winter differ, in some degree, as day and night do; and they likewise merge into each other imperceptibly. In summer there are more light, more heat, and more food, and also greater activity of the vital processes. In spring and summer, as compared with winter, the pulse of an animal is quicker, the temperature higher, and, in short, metabolism is more active. With each recurrence of spring, life, comparatively dormant during the winter, bursts into renewed activity, and the hibernating animal comes out of its quarters, revives, and takes on renewed activity. Reproduction of all kinds of animals takes place at this season of the year. There is also a great increase in peripheral growth, for instance, of hair, nail, and hoof, and the old hair and cuticle are shed.

We concluded, above, that increased vital activity had been for such a long time associated with day as to explain the fact that organisms exhibit a rhythm corresponding to the alternation of day and night. Now there is also some evidence to show that organisms exhibit another rhythm corresponding with the alternation of summer and winter. According to the Rev. J. G. Wood, some Australian plants, set in the suburbs of London, made an attempt to blossom just as our winter set in; but in the course of a few years they were gradually later in blossoming, until they had found the proper season, and thenceforward they put forth their leaves and flowers at the same time as our indigenous plants.

When animals are first introduced into a fresh environment, they sooner or later enter into competition with one another. At any time many of them may be called upon to fight, or to make good their escape. In either case, the associates of work

are evoked, since, in fighting, anger and rage and redoubled energy are displayed, and oftentimes pain is inflicted. Now, the question of pain in its relation to disease on the one hand, and to the injuries received in fighting, on the other, is one of much importance.

Speaking generally, and bearing in mind that there cannot fail to be very important exceptions, which, however, are for the greater part merely apparent and not real ones, pain may be said to be one of the most valuable aids, or rather incitements, to self-preservation wherewith animals are endowed. The more we consider this point, the more clearly shall we see that the tendency of measures which are, in the general way, naturally taken to relieve pain, must be usually such as are more or less directly and more or less markedly productive of advantage to the animal which manifests them. Now pain may be said to consist of disagreeable and irritating sensations, and in response to them an animal may, and often does, put out its best endeavours to remove itself with all speed from the particular source of injury, or danger, which may be the cause of the pain. Or, again, its movements may be determined with the view of satisfying the pangs of hunger or those of thirst, or of supplying some other want or wants which entail suffering. As a matter of fact pain is, among animals, very generally associated with the excitement and furious rage aroused in fighting with competitors or combatants—that is, in direct struggles for self-preservation. This, of course, is the simplest source of pain, and it is naturally most clearly illustrative of the point we are laying stress upon. Among animals which are at any time liable to be called upon to exert their best efforts in fighting, the excitement aroused by pain resulting from bodily injury is especially of incalculable benefit, in so far as it leads to the redoubling of physical effort, exerted with the purpose of overcoming an antagonist.

In an animal suffering pain the associates of work are exhibited. The heart's action is increased, as also is that of those muscles which in fighting would be more or less directly concerned. Even the muscles of the ears, eyes, and lips, may be in some degree brought into action. Likewise when an animal is undergoing pain, there are exhibited more or less intense excitement, perspiration, and perhaps screaming. How-

ever, these associated functions concur in animals, and in man, not only when they are consciously and suitably directed to the removal of a pain-giving agent, but also when the pain cannot be thus removed, being due, as in disease, to causes of quite a different nature. In the former case the reactions are directed to measures of self-preservation, leading as they do, to redoubled efforts at defence, while in the latter case they may be not only not beneficial but even of a very harmful and even fatal character.

When the pain results from morbid processes, the harm done by the reactions of the organisms is oftentimes excessive, while

FIG. 17.

the benefit is reduced to a minimum, or may be entirely absent. Thus, as in the case of ordinary physiological processes, so also in those which are called abnormal, certain remnants of "antique customs" still remain to clog the wheels of more highly developed processes. Just as certain rudimentary structures, not only useless but even harmful, remain in higher animals to interfere with the working of newly-constituted organs, so, too, organisms may be said to make, now and again, great and sometimes even fatal mistakes in the processes by which they attempt to throw off the results of injuries, or to atone for damaging changes. In other words, it seems that the working of normal physiological mechanisms may be said to entail even

fatal mistakes when those mechanisms are set going by processes of disease. The conditions, though similar, are really different, and hence the ordinary reaction being put forth cannot be a successful one.

In an acute attack of gout the manifestations of the febrile disturbance, which is supposed to be secondary to the joint affections, are acute pain, rapid pulse, some rise of temperature, perspiration, great restlessness and excitement, and possibly screaming.

Further, it is a most noteworthy fact that the pulse of an animal suffering pain, if not of too intense a character, is almost invariably accelerated. Restlessness and vigorous action of the muscles are likewise manifested by animals which are in pain. The leg of a frog contracts when the toes are irritated by an acid, or by other means. Indeed, that movement accompanies the infliction of pain is well known. We are, in fact, so accustomed to the invariable connection which subsists between these two vital manifestations, pain and movement, that we are in the habit of inferring the presence or absence of pain, according as we do or do not observe its correlative signs. Indeed, it is quite possible we may sometimes be mistaken, for, on the one hand, a cry of seeming anguish may not in all cases denote pain, while, on the other, the absence of signs of pain, as in calm resignation, may not be inconsistent with great suffering. Speaking generally, however, we find that groaning, screaming, perhaps sobbing and weeping, grinding of the teeth, clenching of the hands, violent paroxysms of convulsive movements are seen in most of the higher animals when suffering pain, and it seems that these and the like phenomena can be ascribed to their association in the past with pain resulting from direct struggles with a foe.

In the fight all the muscles and organs of the body receive an intense impetus. The brain is quick to see in advance the tactics likely to be used by the opponent. The heart's action must be accelerated, in order that supplies of blood may be sent freely to any and every portion of the body. The eyes and ears also must be more sharp than usual, and hence the muscles connected with these sense organs must be on the alert, and ready to set them to the best advantage for hearing and seeing, and also to protect them, or at least the eyes, from injuries, as far as

may be possible. In short, nearly all the muscles of the body are liable to be called into action. The wild and piercing cries uttered by a creature almost worsted in the deadly strife, as they re-echo far and wide, may avert a threatened defeat by frightening the antagonist, perhaps, or at any rate by attracting comrades to help. The excitement is associated with more rapid circulation, with quickened action of the heart, with rise of the external temperature, and of the body temperature as a whole.

Now in pain, also, the temperature often rises measurably, and it falls when, as by the influence of morphine or otherwise, the suffering is subdued. In this relation it is well to bear in mind that peripheral increase of heat may occur, though the oral temperature be not altered. The augmented action of muscles and organs gives rise to an increased amount of waste products, and this in due course to sweating and loadening of the rectum and bladder. A man or a horse suffering from the pain of enteritis sweats profusely. There may be also, during pain, as also during excitement, an additional sensibility to cold.

Dilatation of the pupils takes place during pain. Dr. D. A. Gresswell noticed that the pupils of a lad suffering from Peliosis rheumatica dilated whenever one of the elbows, which was exquisitely tender, was accidentally pressed. He has also observed dilatation of the pupils in vigorous children undergoing tracheotomy, in cases when an anæsthetic could not be administered. The pupil also frequently dilates in cases of locomotor ataxy, when an attack of pain comes on. On the other hand, during sleep, when the centres of sensation are dulled, the pupil contracts, as also in opium stupor, in the stupor of typhus fever, in that of typhoid fever, and also in that of relapsing fever, also in the anæsthesia produced by chloroform, notwithstanding that in the stage of profound narcosis which supervenes immediately before death they may dilate. Some animals—for instance, the cat—when preparing for action show dilatation of the pupil; and also in human beings the pupil dilates if sensory nerves be strongly irritated, or as a result of excitement, or during severe muscular exertion.

Dr. D. A. Gresswell ascribes this dilatation of the pupil which occurs in an animal suffering pain to the necessity of obtaining a wide field of view, whether in the alertness needed

for the fight or for the escape from an enemy. He says that in uræmic coma the pupils are generally contracted so long as the patient is free from convulsive movements, but that as soon as a convulsion comes on the pupils dilate. When the convulsion ceases the pupils again contract. Similarly, he says, the pupils dilate in the convulsions of epilepsy. He has noticed also that when a patient is returning to consciousness after chloroform narcosis the contracted pupil gradually dilates; but that if the patient move about the pupil will at once dilate largely, and on the subsidence of the movement again become smaller. He connects all these facts, drawn from so-called abnormal states, with an association (brought about by the struggle for existence) between alertness for action and increase of field of view caused by dilatation of the pupil, an association which he says is due to an inhibition of the nerves of vaso-motor areas in muscles and to a correlated stimulation of the sympathetic nerve which innervates the radiating muscle of the iris of the eye.

The endocarditis of chronic Brights' Disease is attributed to the extra blood-pressure, which indeed is one of the earliest manifestations of inflammation of the kidney. Hence the value of the subjugation of pain in cases of endocarditis and of pericarditis of rheumatic fever may be to some extent due to the coincident soothing of the heart.

We see, then, that the occurrence of pain, due to whatsoever cause, arouses the associates of work, not only in health but also in disease, though, of course, we must not forget that the sufferer may become exhausted, and therefore no longer able to manifest the processes referred to. Now the constitutional unrest which is set up by the pain consequent upon injury must, and does, work harm.

For the sake of example, suppose we consider, for a moment, the case of an animal which has just gained the victory over an opponent, and let us further suppose that the ultimate vanquishing of the foe was the result of the redoubled efforts which were made owing to the reception of an injury which stimulated, or rather evoked, the closing energetic and successful struggles.

In connection with this most important question of pain in its relation to vital activities, Dr. D. A. Gresswell would add that not pain alone, but the mere apprehension of pain due to any want of well-directed and sustained effort—which would

give advantage to an opponent—would necessarily come to be correlated with the associated factors of work.

Now it is clear that the pain, still continuing after the receipt of an injury, would be of further value, perhaps, only in so far as it would dictate rest of the parts injured, while, on the contrary, at the same time, in very many cases it would undoubtedly be productive of harm by reason of the general disturbance and unrest still kept up, although probably it might no longer be necessary for purposes of protection from the foe. Hence we find that a dog or a deer, for instance, which has met with a fracture of the leg, or any other similar injury, seeks quietude and dark seclusion. At each movement of the fragments pain ensues, and consequently the poor creature tries to avoid suffering by calm and repose. The resting of the leg, the general motionlessness of the body as a whole, the fasting, the absence of disturbing influences, the darkness, all these factors lead to a diminution of the constitutional excitement. Similarly, it is almost invariably the case among oxen, that when one member of a herd is taken ill, the first, or one of the first signs of disorder is that that particular animal departs from the rest of the herd in order to bear its sufferings in solitary seclusion.

We cannot finally dismiss the most important topic of pain without recording some of those wondrous triumphs over pain which have been acquired by various races of men. The Mandans, otherwise called the See-póhs-ka-numáh-ka-kee—that is, the People of the Pheasants, when visited in 1834 by Mr. Catlin, the great American traveller, in his journeys through the North American forests, were a small tribe of 2,000 souls, living in two villages on the great river Missouri, 1,800 miles above its junction with the Mississippi. These hardy warriors could endure with invincible apathy and fortitude all the forms of torture which the ingenuity of their enemies could devise. This apparent insensibility to pain and fear is not, however, to be attributed to more callous frames or nerves of obtuser feeling, but to the astonishing results of their institutions and the influence of their public opinion. Place a sufficient motive, indeed, before a human being, and the proper witnesses around him, and he may be disciplined to endure anything without showing a subdued spirit. The Mandans lived in earth-covered lodges, and their villages

were defended by strong piquets or stakes, eighteen feet high, and a ditch. The chief wore a splendid costume, with a head-dress of raven's quills, and he carried two pipes of peace in his hand.

In about three years after Mr. Catlin's visit small-pox destroyed all but thirty-one of the tribe, and these were speedily cut off by their enemies, and the whole race thus became extinct. While resident among the tribe, Mr. Catlin painted four notable pictures, and in reference to them he explained that the subsiding of the Flood was commemorated at an annual ceremony by the Mandans, and that at the same time all the young men who had arrived at manhood during the preceding year went through an ordeal of voluntary bodily torture, after which they were entitled to the respect of the chiefs, and to the privilege of going on war parties.

The first picture represents the interior of the Mystery Lodge of the Mandans during the first three successive days of the annual ceremony. The young men are seen lying around the sides of the lodge, their bodies covered with clay of different colours, and their respective shields and war weapons hanging over their heads. In the middle lies the old medicine man, who watches the young men as they fast and thirst four days and nights preparatory to the torture.

The second picture illustrates the Buffalo Dance, which took place simultaneously.

The third picture represents the interior of the Mystery Lodge, as it appeared to Mr. Catlin on the afternoon of the fourth day. A number of young men are seen reclining and fasting, as in the first picture; others of them have undergone the torture and are taken out of the lodge, and others are seen in the midst of the most horrid cruelties. A scalping-knife, hacked so as to render its edge like that of a saw, is passed through the muscular parts of the body, through the soft parts of the legs and arms and underneath the muscles of the breast and back. Wooden splints or large flat skewers made of a strong wood are passed through these in the flesh, and the young men are hung up to the roof of the lodge by ropes attached to the splints in the upper parts of their bodies, while heavy weights, as buffalo skins, war weapons, &c., are hung upon the splints in the arms and legs, so as to add to the agony of the sufferer. While they are thus suspended in the air by means of their own flesh, each young man is swung round by another with a pole till he faints, and then he is let

down. One is seen who has been let down, and he is offering to the Great Spirit the little finger of his left hand, by laying it on a buffalo skin, while another chops it off with a hatchet. Mr. Catlin, who painted the pictures from life, says that not so much as a groan was heard to come from the tortured, who were anxious to attract his attention that he might represent them with a smile upon their features, which were calm and serene.

The fourth picture represents what was called "The Last Race." After they had all been tortured in the above manner, the young men were led out with their weights, buffalo skins, &c., still hanging to their flesh. A circle was formed, and each of the sufferers, taken by two athletic and fresh young men, one on each side, was forced to run round and round till he fainted away. He was then dragged with his face in the dirt until all the weights were disengaged from him, by tearing the flesh out, when they dropped him, and he lay to all appearance a corpse, until he gained strength to rise and walk home.

All this is the fruit of scrupulous training, and the triumph thus obtained over bodily suffering shows the most serene and sublime ascendency of man's mind over matter, of his spirit over his body. We might say much more on this all-important topic of pain; but we have already gone beyond the limits which we had set.

The subject of irritation may be spoken of separately; for though extreme irritation may merge into absolute pain, we must still draw a line betwixt simple irritation on the one hand and pain on the other.

Irritation of the conjunctiva causes contraction of the lids, that of the nasal mucous membrane evokes sneezing, that of the throat causes attempts at swallowing, that of the rectum causes tenesmus both in animals and in man. These reactions are suitable and conservative. Inflammation of these structures, however, has the same effect yet more pronounced, and then the result is by no means conservative; but, on the contrary, it is detrimental. Similarly, an animal suffering pain from internal causes frequently bites or kicks savagely at the corresponding side of the body, and also in a part which has, apparently, a relation through the medium of nerves with the internal part which is affected. The relief which follows the application of one or more leeches, or of a small blister, to a painful part on

the surface of the body in cases when internal structures are inflamed, is possibly to be in part explained in this way.

Irritation, as we have said above, may be intensified to such an extent as to be nothing less than actual pain, and when this is the case, all the intricate mechanism of work, of the fight, may be called into action instead of small portions only of that mechanism. For instance, a sheep, after all attempts to dislodge the œstrus ovis have proved unavailing, runs about madly, until well-nigh exhausted with fatigue. A man, too, may be irritated by the harvest bug until he is in a semi-pyrexial state.

Again, if a nauseous and irritating substance be swallowed, vomiting may ensue. In fact, if an irritant be present in any portion of the digestive tract, either vomiting or defecation, or both these processes, may occur. In most instances it is without doubt best that substances which are nauseous or irritating should be thus rejected. This reflex action, however, which is in these cases of such supreme importance, persists under pathological conditions when it works harm. So alive are the intestines to the reflex effect caused by irritation that vomiting may occur in enteritis, or owing to compression of a portion of gut in a case of hernia.

Vomiting may also occur if structures in close relation with the intestines are injured, for instance in peritonitis, in compression of the mesentery in a case of hernia, in biliary colic, in irritation of the fauces. So also tenesmus may be excited by irritation and inflammation of the lower part of the intestines. In many of these cases the reflex effect is productive of harm. There is reason to believe that the irritation of the throat is a part cause of the vomiting which occurs at an early stage in cases of scarlet fever; and since vomiting also occurs at the onset of diphtheria and small-pox, in which the fauces are attacked, and also closely follows the onset of other cases of inflammation of the fauces, it seems as if in all these cases the irritation were the cause of the vomiting. Similarly, violent coughing may bring on retching, which is apparently due to the irritation of a pellet of mucus which has been coughed up into the throat.

We may say, then, that the alimentary tract is peculiarly sensitive, and that while this sensitivity in normal processes does good, it may in abnormal conditions work a vast amount of harm. We may also conclude that irritation, in like manner

with pain, brings about, to a greater or less extent, the associates of work, and this not only in healthy animals, but also in those which are suffering from the abnormal processes of disease.

In continuance of our discussion we now turn to the subject of fear.

All gradations may be witnessed in man and animals betwixt the ready action of fear and the incoördination and paralysis of fright. Fright may bring on palpitation, an irregular and intermittent beat, or a cessation of the beat. The paralysing effect of fright is well known.

While, then, fear calls up the associates of work, the exertion needed for escape, or that of the fight, fright is fear carried to such excess that paralysis ensues.

Hence it is the case that, of our therapeutic measures, those which excite to action on the one hand, and those which induce rest on the other, are of great importance. Among the former we may include physical work, external light and heat, noise, food, out-of-door scenery, stimulants, tonics; while among the latter we may mention reduction of work, of external light and heat, of noise, and of food, sedatives, venesection, reduction of irritation, of pain, and of excitement, not only that of pleasure, but also that produced by fear.

Tales of success excite and stimulate, those of happiness produce happiness, tales of failure depress, and it must be remembered that in some cases of diseases excitement is more easily produced than it is in health.

Dr. D. A. Gresswell relates the case of a boy in the convalescent stage of pneumonia, who was so excited by a noisy delirious patient in the next bed, that his temperature rose from the normal point straightway to 104·4 deg. F. About an hour and a half later, his temperature had fallen 1·8 deg. F., so as to be 102·6 deg. F., and next morning at 8 a.m. it was 98·2 deg. F. It then oscillated up and down for seven days, after which it remained at the normal. Similarly, a patient, convalescing from enteric fever, if excited by pleasure or by fear, almost always expresses the excitement by a rise of temperature.

And now, in conclusion, let us for a brief moment cast a swift glance backwards at the glorious history of science. How clearly does it appear, when we do so, that its gradual but sure growth in accordance with all the co-operating factors, and also

in most intimate correspondence with all those various involved conditions to which man's intellectual powers have been, and are being, subjected, furnishes in itself one of the very best of all those innumerable examples which we can adduce in illustration of the general process of evolution. With exceptional force does this statement apply to the science of comparative pathology, a science even yet in its earliest infancy. Indeed it is only most recently that the gradually increasing firmness of the establishment of the doctrine of evolution as a relatively true, real and indispensable, fundamental basis of thought and fact, has led men to inaugurate their initial attempts to unravel by its aid the intricate clues to the varied and at first sight most mysterious phenomena of disease. The discovery of modern microscopic methods has concurred to help the tide of progress in medicine to a marvellous and well-nigh incredible extent. Indeed, in the field of pathology, the advances made during this present century now about to close, have been truly wonderful in magnitude and far-reaching importance. Yet wondrous and great as they have indubitably been, these discoveries are probably almost as nothing when compared with the new developments of our knowledge which we may expect to be made ere long.

Probably the most important epoch of all epochs, so far as the world of medicine is concerned, may be said to be this present one, which has been marked by the promulgation of the germ theory of disease, and by its subsequent elaboration which still proceeds, and will continue to proceed with yet more rapid strides. Indeed, it would be quite impossible to exaggerate the importance of the influence exerted by recent discoveries, both in reference to preventive medicine and to our knowledge of the best modes of treating the different disorders with which all human beings and animals are liable to be affected.

Day follows day, the years roll on, and as the wheel of time revolves, it brings with it more and still more accurate information, which is furnishing an entirely new basis for the sciences of medicine and surgery as pursued by our predecessors.

The discovery of the power for good of vaccination, the recent establishment of the germ-theory of disease, and of its numerous and weighty implications in regard to actual treatment, the employment of antiseptic measures, the inoculatory methods which have proved so highly successful in the hands of M. Pasteur,

his co-workers, and others, certain most valuable new lines of medical treatment—all these initiations of quite modern times are very intimately connected one with another, and they open up quite a vista of unexplored regions. Just as the elaborate science of morphology has arisen out of the crude anatomy of earlier days, so must the true science of pathology be developed from the basis of our present knowledge, the starting-point from which we may see a dim vision of a goal.

As a provisional explanation of the mode of development of organisms, in the case of the tribe no less than in that of the individual, and in many other ways, the hypothesis of evolution has already been of incalculable advantage. The benefits hitherto derived are, however, immeasurably enhanced by the importance of the light now being thrown upon vital processes, both normal and abnormal, by those who are, whether consciously or unconsciously, now being guided by the idea of evolution in their methods of research. In every department of knowledge this theory is exerting the very greatest influence ; but there is no science which is destined to be so profoundly affected for good by it as is that of comparative pathology, the true and rational science of disease.

In fine, it must be held a primary and fundamental assumption that just as all animals have presumably had a common origin, in like manner all functional and structural disorders present connections of the very highest interest and importance one with another. In short, the phenomena of disease are to be studied from their comparative aspect, no less than by their special manifestations. This is a point of view which men of light and leading are now applying with the best results, and herein is opened out a new field for investigation, which in the very highest degree demands cultivation on account of the wondrous usefulness of the knowledge which is to be gained thereby.

And let us never falter or waver on our way upwards towards the great truths above us, and never rest contented unless we are climbing—it may be very toilsomely—over rocks and crags, and huge mountain boulders, and beside deep chasms and pitfalls, yet still always climbing upwards and onwards, higher and ever higher, higher and yet higher still.

CHAPTER VI.

DISEASES OF THE OX AND SHEEP.

SECTION I.—GENERAL DISEASES.

PLEURO-PNEUMONIA.

Two distinct bovine diseases are known respectively as Sporadic Pleuro-Pneumonia and Epizoötic Pleuro-Pneumonia. The similarity of the name arises from the fact that in both maladies the lungs and their coverings are liable to be inflamed. Sporadic Pleuro-Pneumonia is a disease which is considered to be native, while the Epizoötic form was first known in England in the year 1841, being of foreign origin. While the former is readily amenable to judicious treatment, the latter is said to be fatal to the extent of about 52 per cent. The *post-mortem* appearances, though similar, have distinctive features.

Sporadic Pleuro-Pneumonia.—This disease may commence either in the lungs or in the pleura. In some cases it is more like pleurisy and in others more like pneumonia. It is traceable, as a rule, to such causes as exposure to cold and wet, especially if the animals are subjected to bad ventilation or faulty drainage in addition. It is most prevalent in inclement seasons, and it has apparently no tendency to spread from one animal to another. Unless all the members of a herd are similarly exposed to the same predisposing conditions, the malady seems to attack individuals, and it does not apparently spread by infection.

The onset is sudden, and marked with acute febrile symptoms. The disease has a rapid course, usually terminating in about nine

days. It is essentially amenable to judicious treatment, and is not fatal as a rule, provided that the patients be tended with care and skill. The malady seems to have no incubative stage. Both lungs may be more or less uniformly affected throughout their entire substance. If the lung is examined after death, the yellowish interlobular bands, so characteristic of the epizoötic pleuro-pneumonia, are not so markedly visible.

EPIZOÖTIC PLEURO-PNEUMONIA (HISTORICAL, GEOGRAPHICAL, AND GENERAL).—The earliest records which can be found relating to this justly dreaded scourge point to its prevalence in Central Europe. Valentine speaks of an epizoöty, which may possibly be regarded as contagious pleuro-pneumonia, as having occurred in Hesse in the year 1693. Bourgelat mentions the disease existing in Franche-Comte in 1769, calling it *murie.* The malady appeared in Prussia in 1802, soon spreading over North Germany, in Russia in 1824, in Belgium in 1827, in Holland in 1833. From Holland Epizoötic Pleuro-Pneumonia, then raging in Friesland, was imported into Great Britain in the year 1841. The scourge is now more or less prevalent in all our colonies, and, in fact, in nearly all parts of the world. It is still, however, said to be almost unknown in Hungary, and has, we believe, never yet appeared in Normandy nor in Algeria. The disease, now thoroughly established in the British Isles, breaks out with greater or less virulence in certain districts from time to time, carrying off large numbers of cattle, and this despite the most stringent regulations which issue from Her Majesty's Most Honourable Privy Council. This is nowise to be attributed to any omission or to any want of vigilance on the part of the Agricultural Department of the Privy Council Office, but simply to the fact that there seems to be no possible means of absolutely stamping out the disease. To this topic we shall refer again.

The malignant fever we are discussing is spoken of as contagious, or zymotic, or epizoötic pleuro-pneumonia, and is also designated by various other names. It may be described as a sub-acute specific disease, which spreads with fatal rapidity through the medium of the air. The manifestations are seen in the bronchi, and in the lung-tissue and the lining membranes of one or both lungs. There is an extensive exudation of a fluid in the interior of, and on the lining membranes of, one or both

respiratory organs. The name pleuro-pneumonia indicates that changes of an inflammatory character are found both in the pleuræ (the lining membranes of the lungs, and of the chest cavity) and in the lungs themselves. There is also an effusion of lymph into the pleural sacs. Usually the bronchi become more or less stopped up. The inflammatory process spreads along the lymphatics. Acute pleurisy, with high fever and various functional derangements, may occur. The disease is of a highly contagious nature. Bovine animals only seem to be attacked, though it has been said to extend to the deer, and some think it is allied to some forms of acute croupous pneumonia of the human subject. It is allied to the general specific diseases, and one attack apparently confers immunity.

Causes.—We may naturally suppose that there are usually certain conditions which, while aiding in the development of the disease, do not actually cause it. They are the following:—Too much food, improper or sudden changes in the food, prolonged feeding on the residues of distilleries and breweries; excessive milking, hot or damp byres, marshy and badly-drained pastures, cold, damp, bad water, faulty sanitation. In short, all those conditions which will damage a healthy animal, will, it is thought, render it liable to the attacks of this disease, if the specific virus is at hand even in small quantities. The traffic in diseased cattle adequately supplies this virus, and thus accounts for the diffusion of the disease. It is thought that severe weather, bad feeding, and all conditions of an injurious nature cause a greater susceptibility to the ravages of this disease, but that they do not bring about its spontaneous origin.

As yet we have not very accurate information as to the germs of this disease. It is said by T. Poels and Dr. W. Nolen that the micrococci of pleuro-pneumonia of cattle have been successfully cultivated, and that the pulmonary exudations contain micrococci identical in form and mode of growth with those found in human pneumonia. These observers also make the important assertion that cultivated micrococci, derived either from human pneumonia or from pleuro-pneumonia of cattle, produce in cattle typical pleuro-pneumonia. Dr. Klein, from his own observations, feels disposed to doubt the accuracy of these statements. At any rate, it may be regarded as established that contagious pleuro-pneumonia is generated by, and due to,

a definite micrococcus, and there can be little doubt that the virus is inhaled by the animal, and so enters the lungs. It seems probable that the lining membrane of the air-tubes (the bronchi) is first affected.

COURSE OF THE DISEASE—PERIOD OF INCUBATION.—It is said that an animal may be infected with the germs of contagious pleuro-pneumonia long before any marked signs of its presence are indicated. This is called the "period of incubation," and it has been said to vary in length from two weeks to as much as six months. Generally speaking, signs of the disease are apparent after about thirty-seven days. Owing to this long period of incubation the disease is especially insidious, since it may spread among large numbers of cattle before it can even be detected. Animals, apparently healthy, may convey the disease to others by exhaling the germs. Very generally the first signs of the disease are not noticed.

GENERAL CHARACTERS OF THE SYMPTOMS.—The disease is more rapid in young and vigorous animals than in the old, weak, or sickly. Contagious pleuro-pneumonia may be acute, sub-acute, or chronic in character. In the first case, large portions of the lungs may be rapidly invaded. In sub-acute or mild attacks, the patients may get well in what is called the first stage. The normal condition of the lungs, however, is rarely, if ever, regained. In chronic or prolonged cases, too, the animals may recover, though this is seldom seen. The cough persists for a long time, and it is accompanied by the expectoration of a great deal of muco-purulent matter. The recovery is often, we might say generally, incomplete, signs of the disease remaining one, two, or three, months, during which the animal may infect others. The immediate cause of death may be general weakness, brought on partly by the absorption of the products of inflammation, partly from other causes. If the febrile symptoms of the second stage come on rather late, the disease may last for several months. We proceed to consider the first or developmental stage, and shall then go on to the second or febrile stage, in which the disease comes to a crisis.

First Stage.—This stage may continue only a few days, or it may be prolonged for from two to six weeks. An elevation of temperature, or, according to some, a slight cough, is the first sign of disturbance. Of the members of a herd supposed to be

infected, those animals whose temperature is under 100° F. may be looked upon as healthy.*

Those oxen in which the temperature is over 100° F. up to as much as 102° F. may be affected; while those animals whose temperature is between 102° and 104° F. are very probably subjects of disease. The temperature may rise as high as 106° F., or even higher. It is well to bear in mind that this may be observed even a few days before the disease is manifested in other ways. If there is reason to suspect the presence of contagious pleuro-pneumonia, a temperature of 102° F. would prove the necessity for prompt isolation, thorough disinfection of the sheds, and precautionary measures; slaughter, if slaughter has been determined upon; preventive inoculation, if this is considered admissible.

The general signs of ill-health soon appear. There may be a shivering fit, or more than one. The infected animal may separate itself from the herd. The appetite is less keen, or of an irregular character. The patients chew the cud with less vigour, more slowly or irregularly; there is a slight, dry, weak cough, usually in the morning and evening, when the animal rises or is disturbed, when it leaves the shed, after drinking, or when pressure is applied between the ribs. Gradually, as the disease progresses, the cough becomes more frequent, harsh, and painful, and when the animal is coughing, its back is arched, and the head and neck are extended. The number of respirations per minute is about thirty or more. Breathing is a difficult and laborious process. The nostrils are dilated, and the flanks heave, what is called "a staring condition of the coat" may be seen, the hair loses its healthy lustre, and here and there stands upright; the mouth is hot, the muzzle dry, the gums are of a pale lilac colour, the walls of the chest, and particularly the spaces between the ribs, and the back from the withers to the loins, are generally all more sensible to pressure than is usually the case in a healthy beast; the appetite becomes worse, the secretion of milk, if the patient be a cow, diminishes, and emaci-

* The late Professor Robertson took the average temperature of 352 oxen, including 100 cows, "all believed to be in the full enjoyment of health." The average morning temperature was 101·65° F. The average evening temperature, taken from over 200 animals, was 102° F. The average number of respirations per minute, taken from 250 animals, was 30·25.

ation sets in; the bowels are irregular, a serous or sticky discharge comes from the nostrils; the pulse is often quicker than in health; the ears and horns may be hotter than usual, or they may vary in temperature.

By auscultation with the ear or with a stethoscope we may detect sounds of an abnormal character in the bronchial tubes, and mucous *râles* and crepitations over the lungs. One or both lungs, more especially towards the lower third, are affected. The mischief in the lung or lungs increases slowly in extent and in intensity. The air-cells become impervious to the air, in greater or less degree blocked up with the fluid exuded into them. The lining membranes of the lungs and of the chest-walls are also infiltrated with a fluid exudation. The bronchi have inflamed walls, and they may become occluded, being filled with a solidified lymph, as also may the air-cells. Sometimes the changes in the lungs may be so extensive that death may occur during this stage.

We must remember that any division of symptoms into stages must necessarily be arbitrary, and that probably these extensive changes we have just described would be more appropriately considered as a hurried and sudden setting in of the symptoms to be now described as belonging to the second stage.

Second Stage.—Many of the symptoms mentioned already are now exaggerated. The fever is of a more decided character. If the animal moves, it does so unsteadily and with pain. The cough is more persistent, harder, more frequent, more painful, and among the expectorated matter there may be white or straw-coloured casts, tinged with blood. The mechanism of breathing is altogether out of order. The respiratory movements are quicker, more laborious, and accompanied by low moans or grunts. The whole body often shakes with the agonising efforts to breathe. Pressure or percussion on the chest, and especially in the spaces between the ribs, close behind the elbow, or upon the back and loins, gives rise to a crouching or shrinking, together with a low moan devoid of resonance, indicative of pain. The attitude of the animal also bespeaks the desire to facilitate respiration by whatever means, and to avoid the pain occasioned by the vigorous respiratory movements. The fore-legs are wide apart, the elbows being twisted outwards to relieve the chest from

pressure. The animal often changes the position of the hind-legs, and seldom if ever lies down.

If, when nearly wearied out by the ravages of disease, the subjects of pleuro-pneumonia assume the recumbent posture, it is but for a short time that they do so, and even then the same untiring effort to breathe may be seen in that they rest on the middle line of the chest, with limbs doubled up under the body, or perhaps with the fore-limbs extended in front. The animal stands with muzzle protruded, and with the neck extended almost in a straight line. The back is arched, the nostrils are more markedly dilated, and the flanks heave more violently. The mouth is hot and clammy, the muzzle dry, the breath fetid. There may be even a suppression of the milk and a complete loss of appetite. Only small quantities of fluid can be drunk, and the swallowing even of these produces coughing. There is a watery discharge from the nose and eyes, and this may become purulent and offensive in odour. The extremities, horns, ears, and other parts of the body may be at times hot, at times cold. The mucous membranes are injected, the bowels costive, the feces being hard, dark, and rarely voided. The urine is scanty, and of a high colour; the skin previously dry, harsh, and tightly bound to the tissues beneath, clinging to the bones and feeling tense, like parchment, becomes yellow, dirty and scurfy. The body wastes, and the animal becomes exceedingly weak.

There may be slight shivering fits. The pulse full, fairly firm and averaging about 73 per minute in the earlier part of this stage, afterwards becomes much smaller and feebler, and sometimes intermittent and irregular. Indeed it may be scarcely perceptible. The heart's beats are of a bounding character, and are said to become more tumultuous as death approaches. There may be a venous pulse on account of the obstruction to the pulmonary circulation. Auscultation and percussion indicate that extensive alterations are proceeding in the lungs and chest cavity. If the ear be placed at the bottom of the neck, in close contact with it, a loud rushing sound of air is heard. At the top and side of the chest, a little behind the shoulder-blade, the sounds heard are still louder. Behind and below these parts, however, no sound, or only slight whiffing and wheezing noises, can be detected. This absence of sound indicates consolidation of the lung or existence of fluid in the chest, and in these cases

percussion gives rise to a dull note. The "friction-sound" may also be heard. It results from the rubbing of the enlarged lungs against the sides of the chest.

Sometimes only one lung is affected, and then the respiratory murmur (as the normal sound is called) is heard much more plainly than usual on the healthy side, being more resonant, and then called puerile or exaggerated. The unaffected lung in fact tries to make up by stronger action for the deficiency of its fellow, thus being to some extent compensatory. Sometimes the normal functions of the lungs may be gradually resumed, the products of inflammation being absorbed by slow degrees. Generally there is water in the chest. A portion of the lung may become gangrenous and then detached. Sometimes abscesses form in the substance of the lung, and leave cavities which give rise to the production of special sounds, which vary in character.

The approach of death is denoted by hurried and anxious breathing, the cough being almost continuous. The animal seems unconscious, almost insensible to pain, and is scarcely able to stand. The attitude of the animal when recumbent is noteworthy. When lying down, the animal rests on its side with neck outstretched and discharging from the open mouth a thick saliva. All the mucous membranes become lividly pale. The animal groans loudly as if in agony, grinds its teeth as if in despair, though probably these signs do not prove real pain so much as the very strenuous efforts which are made to breathe. A dropsical or œdematous condition of the skin is seen in the region of the dewlap or beneath the chest and abdomen, and also in the extremities, in short in those parts where the circulation is most inactive. The body wastes, and an offensive diarrhœa comes on. *Hoven* may be present, the abdomen being blown out with gas. The animal, having become weaker and weaker, at last drops and dies.

The end may come in two or three weeks after the second stage is reached, though the animal may die of asphyxia at an earlier period. When recovery has not taken place, there has been, as a rule, progressive consolidation of one or both lungs, and the gradual increase of effusion of water into the cavity of the chest and of fluid into the lung-tissue.

Death is said to take place frequently on the sixth, eighth, tenth, fifteenth, or twentieth day from the beginning of the

disease. It is due generally to actual loss of the power of breathing, sometimes to pulmonary gangrene. A fatal termination may be precipitated or hastened by a sudden distension of the rumen by gases, a result of the arrest of digestion. Thereby, the lungs, already fearfully handicapped, are still more markedly impeded, and asphyxia is the result.

In some cases the animal may linger on for a long time. The sunken eyes discharge an offensive secretion, and the animal wastes day by day. The temperature sinks to a very low point. Among the putrid pus which is expectorated portions of disintegrated lung are coughed up.

Post-mortem Appearances.—In the case of animals which have died rapidly, the lung tissue is red or even black, loaded with a great quantity of serum, and very soft and easily broken. The chest may be opened by an incision, say into an intercostal space. The ribs being broken at their union with the spine above, and with the breast-bone below, a yellowish fluid flows out from the cavity of the chest. This fluid contains much albumen, and is liable to form a gelatinous clot if it is exposed to the air. It varies in amount from a few ounces to several gallons. This flow of fluid is seen in those animals which have died when the disease is well advanced. Large flakes of a yellow fragile substance float in this liquid. Further, if the chest be opened by the divided portions of the sides of the chest being raised, at certain parts the inside of the chest-wall is found to be adherent to the lungs, these latter organs being tied to the inner surfaces of the ribs by means of large deposits of the same yellowish friable substance which floats in the liquid. The pulmonary pleuræ (the layers which line the lungs) are nearly always thus invested with a firm, solid layer on one or both surfaces. These layers constitute the so-called "false membranes." If the layer on the lung's surface is stripped off, the lung is left rough and dotted with small eminences. The lining membranes of the lung and of the chest-wall, where not connected, have a dull appearance, and both are covered by a layer of fibrin. The tissue beneath the pleuræ, which is continuous with the bands separating the lobules, is also infiltrated.

These membranes largely consist of "fibrin," being sometimes spoken of as coagulable lymph, but better called coagulated

lymph. When a portion is examined with the microscope, cells, like the colourless corpuscles of the blood, and like pus cells, are found embedded in it. No doubt they are of the same nature as these cells. The fluid in the chest and the false membranes may be considerably less in the pleural cavity on one side of the chest than in that of the other. The lungs may be also united by bands of fibrin (which are easily broken) to the heart-bag (pericardium), and also to the midriff (diaphragm). The tissue connecting the cardiac fat is thickened. The lining membranes of the lungs, as well as those of the chest-walls, and also the bronchial tubes and blood-vessels, are all affected. There is, in fact, an extensive exudation of a yellowish fluid, called serum or coagulable lymph, in the lungs and the structures closely connected with it. This coagulates to a greater or less extent, and thus portions of the lung or lungs become mechanically obstructed.

It is said that the first change is that the blood-vessels of one or both lungs dilate. If the animal is killed soon after being attacked by the disease, a more distinct scarlet hue may be noted in the affected lung or lungs. These organs, being full of blood and of the products of the abnormal processes going on, are consequently heavier, and sink further in water than healthy lungs do. As the disease proceeds, they become heavier and heavier. A healthy lung floats in water, has a bright salmon colour, is smooth, elastic, and yielding, and weighs about $6\frac{1}{2}$ lb. The detached lungs of an animal that has died of pleuro-pneumonia are enormously heavy. Indeed, one diseased lung alone may weigh as much as 30lb. The two have been known to weigh from 20lb. to as much as 75lb., or even 1 cwt. The pleural linings are rough and thick, and the lung substance is hard and inelastic. Being consolidated in a greater or less degree, they resist pressure and do not crepitate when incised, owing to the air-cells being blocked up. It is readily seen that such lungs cannot fill themselves with air by expanding, and empty themselves by contracting. In other words they cannot fulfil the function of breathing.

If the lung is cut with a knife, the exposed surfaces present an appearance most characteristic of this disease. It has been termed a "marbled" appearance. This same aspect is seen in the cut surface of the lung of a horse which has died of pleuro-

pneumonia of long standing, and also in cases of sporadic pleuro-pneumonia of oxen, but in neither of these instances is it so well marked as in contagious pleuro-pneumonia of oxen.

In animals which have only reached the first stage of the disease, the tissue which binds together the lobules of the lungs is seen to be chiefly involved. This tissue in the interior of the lung is continuous with that which surrounds the organ underneath the covering called the pulmonary pleura; and it forms, so to speak, a supporting framework by which the lung is held together, and divided into lobules. These partitions, or rather walls, between the lobules are called "interlobular bands." Now these bands, or rather walls, of the lobules (for it is only in sections that they look like bands) are impregnated with a yellow fluid called serum in different parts of the substance, generally towards the centre, of one or both lungs. Now the "marbled appearance" results from the existence here and there in the tissue of the lung of dark red or purple areas engorged with blood-discs, fibrine, &c., separated by these "interlobular bands."

The latter are really *walls* of lobules, but on section they naturally appear like *bands*. They vary in breadth from one-twelfth to one-third of an inch, are greyish or yellowish, being sometimes streaked with blood. These interlobular bands are engorged with fibrin, which seems to have been deposited owing to the distension of the lymph-vessels which are contained in them. In accordance with the progress of the disease, these bands become thicker and firmer, and sometimes they may be so greatly stained with blood that several lobules may seem to be united to form one patch of congestion. Here and there, too, the lung-tissue may be but little affected by disease. Small groups of lobules or single lobules may be invaded, and those parts which are affected are not necessarily contiguous, this inflammation being in this respect like the pulmonary inflammation brought on by glanders in the horse.

In accordance with the degree to which the disease has progressed, the products of the abnormal processes may be absorbed, or may form new tissue, the air-cells disappearing. The affected lung-tissue, which was at first brownish-red in colour, gradually becomes filled up with fibrine or coagulated lymph. Portions of the lungs which have thus undergone fibrous degeneration are

deprived of their functions. This solid substance mechanically alters the processes going on in the lungs, the blood-vessels and lymphatics being thereby subjected to pressure. The new tissue may undergo fatty, caseous, calcareous, or in rare cases gangrenous degeneration. The air-cells usually contain a little serum. Sometimes, though very rarely, they contain fibrine. They are sometimes, therefore, obliterated, and sometimes densely packed with red and white cells, as in ordinary pneumonia (red hepatisation). The exudation may then become a whitish turbid fluid, so that the lung appears greyish, and thus we have "grey hepatisation" instead of the more general "red hepatisation," in which the lung tissue looks bluish red or purple.

Sometimes the tissue suppurates, and masses of lung tissue may be detached and isolated in the midst of a thick purulent fluid, contained within rigid walls of newly-formed connective tissue. In some cases these detached portions are decomposed, friable, offensive in smell, and produce gangrene in the adjoining tissues. Sometimes there may be found large or small cavities filled with more or less fluid pus. Thus there are abscesses in the substance of the lung, and sometimes, though not frequently, they open into the chest cavity, producing what is called empyema. A cavity is then left in the lung which gives rise to the amphoric râle. The pus may be partially absorbed, and produce purulent infection, or the abscess may discharge itself through the air tubes, in which case there will probably be an expectoration of fetid pus.

Necrosis may result, too, from pressure of the bronchial vessels, or from thrombosis of the bronchial arteries. The pulmonary arteries are liable to thrombosis and embolism, and thus gangrene may be produced. Gangrene is evidenced by the brownish or nearly black hue of the lobules, the interlobular bands being thin and infiltrated with bloody serum, and the lung tissue being easily torn and fetid.

Blood abstracted at an early stage of the disease is usually viscid, thick, and soon coagulates. At a later stage it has become dark and fluid, and has lost its coagulability. "The stomach contains dry food, and its lining membrane, as well as that of the intestines, may exhibit patches of congestion."—(Fleming.) It is said that there is more effusion into the pleural cavities in some epizoöties than in others. As a

rule the inflammation is more marked in the lung tissue itself than in the pleuræ, but in some cases the reverse is said to be the case.

The air-tubes, the veins, arteries, and lymphatics, are surrounded externally by exuded lymph, and at the same time tend to be obliterated internally by the clots which are formed within them. Many of the air-tubes generally contain frothy serum, and those of the diseased part are frequently occluded by clots of fibrine, which may extend into the larger tubes as hollow cylindrical masses. Thus we find in the interior of the wind-pipe and of the bronchial tubes large quantities of coagulated lymph, which sometimes blocks up the passages to such an extent as to form hollow or solid counterparts of the air-tubes. This has been also seen in cases of sporadic pleuro-pneumonia.

The lining membrane of the chest, the pleura, is in a healthy animal smooth, glistening, and transparent; but when it has been inflamed, it has an opaque and rough appearance. Butchers sometimes strip the ribs of their pleural covering in order to disguise the marks of disease. The ribs will then be seen to present an unnaturally clean, white appearance. The flesh of animals which have died of the malady is dark, harsh, unhealthy in appearance, moist, or even dropsical. The fat also is yellowish, and there is a general absence of blood.

Preventive Treatment.—We now complete our present subject, pleuro-pneumonia, and as we approach that part of it which is at once most interesting and most deeply involved in doubt, we cannot forbear looking forward in imagination to the standpoint of men who will be writing on this all-important topic of preventive measures years hence.

In view of what has already been done by means of vaccination, and also by inoculation with attenuated virus, we may well believe that by no means the last word has been said regarding these most important operations.

We have said above that the mortality in cases of epizoötic pneumonia is about 52 per cent. Oxen which recover, having escaped the notice of those who would otherwise have ordered them to be slaughtered, may be said to have been, as a rule, affected only in one lung. If both are diseased, there is small chance of the avoidance of death. With regard to treatment, the first

point to be noted is that preventive measures alone are allowable by law. If a beast is known to be suffering from epizoötic pleuro-pneumonia, it must be slaughtered at once. There is no alternative. We shall first deal with preventive therapeutics, then with the methods of inoculation.

There is no doubt that oxen in which the disease is to be anticipated, owing to their having been exposed to the risks of contagion, may be so carefully managed that the disease may be arrested in large measure—almost entirely in many cases—provided that the precautionary measures dictated by the sciences of hygiene and therapeutics and preventive inoculation be carried out with thoroughness. Stringent measures must be taken at once. If the disease itself were to be treated, the most effectual agents that could be recommended would be those of an antiseptic or germicidal character.

The sulphite of sodium, for instance, would be found an invaluable agent. The same kinds of drugs are also of service as preventives. It must, of course, be remembered, in dealing with questions such as these, that there are many conditions which are absolutely indispensable, in order that the action of drugs may be properly aided. Preventive inoculation aided by skilful treatment and care may be thought necessary. On no account whatever may treatment of the disease itself be carried out. The sulphite of sodium, the salicylate of sodium, the fumes of burning sulphur used with the greatest care, carbolic acid, sulphocarbolate of sodium, or iodine, or the iodides might be well tried if treatment were allowable.

We will suppose that the veterinary inspector is called to a case of pleuro-pneumonia affecting a member of a large herd, and so liable to infect many others. He will at once report the matter to the sanitary authorities. The best course of operations would be as follows:—He should at once isolate the affected animal or animals, and have it or them slaughtered. This he is bound to order by Act of Parliament, the Contagious Diseases (Animals') Act of 1878; but there is some latitude necessarily allowed him as to other measures. Of course, he will direct that all sheds, byres, crew-yards, which are in any way liable to be contaminated shall be thoroughly cleansed and disinfected, and he should give detailed instructions how this is best to be carried out.

All sheds, cow-houses, crew-yards and, in short, any place which has contained cattle diseased or supposed to have been diseased, owing to their proximity to subjects of pleuro-pneumonia, should be thoroughly cleansed and disinfected. Sulphur should be burnt with due precautions in braziers in different parts of the premises. In order to obviate future outbreaks as far as possible, every part should be thoroughly steamed out with the fumes of burning sulphur, the gas which is produced, sulphur dioxide, being perhaps the best and most reliable of our disinfectants. After this has been done, the walls, stalls, roofs, and every little nook and corner should be thoroughly white-washed with lime-wash, with each bucketful of which one pint at least of carbolic acid has been mixed. Prompt investigation will then reveal if there are any other oxen affected or likely to be affected. The temperature will serve as a guide in this inquiry. Unfortunately there is some difference of opinion as to the best measures to be adopted with those animals in which the disease is suspected to be lurking. Some think that all suspected oxen should be killed at once, without hesitation. If not slaughtered, all that have been exposed to infection should be strictly isolated. If the animals are "in condition" and slaughtered thus summarily, before the disease has assumed any degree of virulence, the flesh may be used as food. If, however, the animal be for any reason greatly debilitated, or if the flesh has an unhealthy appearance, the meat is not to be deemed fit for human food, but should be buried with antiseptic precautions. The hides, hoofs, &c. should be most scrupulously kept from contact with other cattle.

Dr. Williams held that though the actual disease is not produced by inoculation, immunity against future attacks is secured. He thought that the blood and the serous liquid squeezed from the lungs of an animal in the first stage of pleuro-pneumonia are the most suitable material for inoculation, and found that in from ten days to a month symptoms are produced. He further advises that the inoculation should be performed with great care, and that towards the tenth day a saline purge may be given, and repeated if necessary. He tells us that the morbid changes do not extend to the lungs, but are merely localised in the part inoculated, and that the bovine race seems to be alone affected. We now know that though he may have

been right in other points, the use of the material he recommended is not advisable.

Method of Inoculation.—The fluid should be obtained from the interlobular tissue of a lung of an animal suffering from the first stage of a mild attack, and as soon as possible after slaughter. The parts which are dark red in colour and are consolidated, and especially those parts which look gangrenous, should be most carefully avoided.

The fluid obtained should be of an amber colour, and should be either fresh or at least preserved, so as to be intact and free from the least decomposition. A piece of lung, distended with this yellow semi-fluid substance, should be cut along the lymph-channels, so as to allow this fluid to ooze out. It should then be placed while still warm in a strainer over a suitable glass bowl, covered over with flannel to keep it warm and clean. The clear yellow liquid obtained should be preserved in glass tubes about 4 in. long and $\frac{3}{8}$ in. in diameter, which, when full, should be hermetically sealed by a blow-pipe flame, unless the material is required at once. The hair from the under surface of the tail of the animal which it is desired to inoculate should be clipped off for about five inches from the tip forwards. Then the skin should be cut transversely in two places, one distant about an inch, and the other about three inches, from the tip of the tail. A needle should then be pushed from the lower upwards to the higher incision, and the channel enlarged by a few rapid movements. A piece of white thick worsted, previously well-soaked in the yellow fluid, should be passed through the eye of the needle, pulled through, and left in the skin as a small seton, the ends being knotted so as to cause it to remain in position.

The way we have described is as nearly as possible, we believe, that of Mr. Rutherford, of Edinburgh, a skilled and successful scientist and veterinary surgeon. Professor Williams recommends that the skin should be slightly scarified, and that one drop of the fluid should be injected. It is our belief that this latter method, or rather the simple insertion of the fluid on the exposed surface, is to be preferred. The Professor adds that the upper surface should be inoculated, and that the tip of the tail is selected because, in case of gangrene, which may sometimes occur, the tail may be easily amputated. About the fifth

day, or from that to about a period of two months after the operation, there is a slight local swelling, together with heat, tenderness, and erythema. At about the tenth day an exudation of fluid usually occurs. This looks like that found in a diseased lung. If it is applied to another healthy animal which has neither been previously inoculated, nor has suffered from pleuro-pneumonia, it will reproduce itself, and likewise afford protection against the disease. About the twelfth day there is usually an eruption, together with slight rigors, loss of appetite, and a slight diminution in the secretion of milk.

If the virus is bad, or from other reasons the primary swelling be excessive, the tip of the tail may become gangrenous, and the animal, unless remedial measures are effectual, may suffer from fever, secondary deposits at the root of the tail, around the anus, and in the abdominal glands. Death may then occur in a few days. If the tail should show signs of gangrene, a portion of it should be removed, and the stump, after being allowed to bleed freely, should be then cauterised. In some cases it has been found necessary to amputate the whole tail, and the operation has been performed with success. When the exudation of fluid does not appear until the ninth to the twelfth day, the cases generally do well, the fluid dries up, and the signs of inflammation disappear. The tip of the tail may in time fall off. After about the twenty-first day all danger seems to be over.

Oxen which have been inoculated, and especially cows, should be tended with more than usual care. They should be always kept warm for at least three weeks after the operation, and should never be roughly handled, much less struck. It is highly advisable that the operator should see the animals every day, so as to be ready to act in case of need. If the bowels are constipated, a gentle purgative may be found beneficial. It is well to be sparing with solid food. Especially should roots be withheld for about a fortnight. During this time linseed gruel and the like easily digestible foods should be given. There is no harm in supplying good hay or grass or linseed cake, unless the animal should leave off chewing the cud.

Whatever the weather may be, oxen which have been inoculated should be effectively secured from exposure to cold, damp, or draughts. The risks are greatest in the case of cows, and

in damp or cold weather. If the weather is severe, cows which have been inoculated should have their bodies clothed, and straw should be fastened on to the rafters of the byre. If suffering from any illness, no animal should be inoculated. It is not safe to inoculate cows, until at least sixteen days or more have elapsed since calving. Pregnant cows should not be inoculated after the seventh month. Mr. Rutherford has arrested the disease in over a hundred outbreaks, and the average mortality is not over 2 per cent. Other observers have spoken highly of inoculation, and among those who thought favourably of it was the late Mr. D. Gresswell.

Dr. Burdon Sanderson and others have recommended the injection of the lymph into the venous system, *e.g.* the superficial aural vein, by means of a small syringe. Professors Thiernesse and Degive concluded that intravenous injection is not dangerous, if care be taken that not a single particle fall into the cellular tissue, and they hold that the animal is by this means protected from epizoötic pleuro-pneumonia. The steel canula should be plunged into a vein, and then the syringe adapted carefully; and care must be taken that all the fluid is injected into the vein before withdrawing first the syringe, then the canula. We certainly do not think that intravenous injection is more safe than Mr. Rutherford's method, or that of Professor Williams and other authorities; and it has the great disadvantage that, if by any mischance gangrene should set in, death is inevitable; whereas in the other case the tail can be amputated, if it is the seat of gangrene, or if there is great local disturbance liable to be dangerous to the system.

The conclusions of the Belgian Commission were, shortly, that the phenomena which follow inoculation are those of local inflammation, which is slight in some cases, but may be extensive and affect the system, and may be complicated by gangrenous accidents, so that even death may result; and that the inoculation of the liquid from the lungs of an animal affected with pleuro-pneumonia protects the larger number of animals from the malady for a certain period. The number of animals on which the operation was beneficent was 61·11 per cent., and the recoveries amounted to 88·88 per cent. This average is therefore even better than could be expected, if due allowance be made for accidental factors. Perhaps investigators may ulti-

mately find that an attenuated virus will be the best to inoculate with. We are not aware that this has been yet placed beyond doubt; but every day adds to our stock of power over disease. That it may become still more efficacious is our fervent hope, and, we may add, our earnest belief.

À propos of preventive inoculation we extract the following passage from *King Solomon's Mines*, which many of our readers will doubtless recognise. The talented author, Mr. H. Rider Haggard, will, we feel sure, excuse us quoting from the remarks he makes as to the selection of a waggon and span of oxen. The reader, if he has not as yet procured a copy of the work, is advised to do so without delay, for it is a good book, a useful and practical book, though full of fancy as of merits—a book of the very kind that English people want, and, what is more, will have at any cost. We have read it with intense interest, and, finding in it veritable mines of wisdom, we feel pleasure in saying that we laid it not aside until every word had been read from end to end. Some readers may think there are too many "*good* jokes" in the book, for one cannot help feeling a little disappointment at having to smile in the midst of an exciting situation. But the book, none the less, will do, and has done, a great deal of good, and some will be delighted to hear of Mr. Good and the lovely but unfortunate Kukuana girl, Foulata, who makes a very pretty, and, we will add, a very pathetic picture of fidelity and love. Even Mr. Good himself has, after all, more good in, than neat attire on, him, and at least he will give rise to a very good laugh :—

Having paid this tribute to my bump of caution, I bought a waggon and a span of oxen on Sir Henry's behalf, and beauties they were. It was a twenty-two foot waggon, with iron axles, very strong, very light, and built throughout of stink wood. It was not quite a new one, having been to the Diamond Fields and back, but in my opinion it was all the better for that, for one could see that the wood was well seasoned. . . . It was what we call a "half-tented" waggon, that is to say, it was only covered in over the after twelve feet, leaving all the front part free for the necessaries we had to carry with us. In this after part was a hide "cartle," or bed, on which two people could sleep, also racks for rifles, and many other little conveniences. I gave £125 for it, and think it was cheap at the price. Then I bought a beautiful team of twenty salted Zulu oxen, which I had had my eye on for a year or two. Sixteen oxen are the usual number for a team, but I had four extra to allow for casualties. These Zulu oxen are small and light, not more than half the size of the Africander oxen, which are generally used for transport purposes; but they will live where the Africanders will starve, and with a light load will make five miles a day better going, being quicker and not so liable to get footsore.

What is more, this lot were thoroughly "salted," that is, they had worked all over South Africa, and so had become proof (comparatively speaking) against "red-water," which so frequently destroys whole teams of oxen when they get on to strange "veldt" (grass country). As for "lung sick," which is a dreadful form of pneumonia, very prevalent in this country, they had all been inoculated against it. This is done by cutting a slit in the tail of an ox, and binding in a piece of the diseased lung of an animal which has died of the sickness. The result is that the ox sickens, takes the disease in a mild form, which causes its tail to drop off, as a rule about a foot from the root, and becomes proof against future attacks. It seems cruel to rob the animal of his tail, especially in a country where there are so many flies, but it is better to sacrifice the tail and keep the ox than to loose both tail and ox, for a tail without an ox is not much good except to dust with. Still it does look odd to trek along behind twenty stumps where there ought to be tails. It seems as though nature had made a trifling mistake and stuck the stern ornaments of a lot of prize bull-dogs on to the rumps of the oxen. Next came the question of provisioning and medicines.

We may add that the ready method of inoculation here described was formerly used in England, but inoculation is highly dangerous unless performed with excessive care, though it is said to have been fairly efficacious in some cases.

The current of opinion in regard to preventive inoculation in cases of epizoötic pleuro-pneumonia has recently become somewhat adverse, and the more generally accepted and orthodox belief now entertained in regard to this disease seems to be that the stamping-out policy is alone to be advocated. Some of those who, certainly not without good grounds for so doing, see the unerring certainty of this course as opposed to the great risks which cannot but belong to any other line of action, also as a rule hold that not only is it advisable that such animals as are undoubtedly the subjects of disease should be summarily slaughtered, but also that those which are likely to become affected on account of having been exposed to risks of infection ought likewise to be killed, and afterwards that their carcases should be buried with due antiseptic precautions.

This bold and clear policy, they contend, must be effectual, whereas no other plan can be equally so. Probably this may be the correct view, and at least it seems to have the recommendation of certainty; and, though the question of expense is apt to be a rather serious one, we cannot but conclude, after very much consideration of the matter in all its bearings, that the keen reasoning which cuts its way to what appears to be this sure solution is perchance, in the case of this disease, the best reasoning, just as it was indubitably so in the case of cattle-plague,

and just as it is, with even very much greater potency, likewise the best in the case of the two terrible diseases known respectively as rabies and anthrax. Indeed, in the case of these two diseases, when afflicting animals, no other course can be contemplated by those who know their truly dreadful nature as occurring either in man or in animals. Hence, lest these diseases should be communicated to human beings, any animals affected with them must be forthwith slaughtered, and the carcases properly buried.

FOOT-AND-MOUTH DISEASE, OR APHTHA EPIZOÖTICA.

The highly contagious and infectious eruptive fever, to which the above name is given, owing to the fact that the foot and the mouth are the chief regions affected, varies greatly in point of the intensity of its attack. Although the disease usually affects the ruminants, it may break out in any warm-blooded animal, being met with not only in cattle and sheep, but also in swine, dogs, poultry, and even human beings are not secure against invasion.

Foot-and-mouth disease seems to have been recognised for the first time in England and Ireland in the year 1839, animals afflicted with the malady having been imported from abroad. It is possible that since this time Great Britain has never been entirely free from the germs of the malady, and our readers may remember that there was a marked outbreak in England which lasted from about September 1883 until about the middle of the month of June in the following year. The disease then presented all possible varieties of intensity, for while on some farms it was very virulent indeed, on others the malady was manifested in so mild a form as almost to escape detection. The disease spread rapidly among cattle and sheep, and the pigs also frequently took the infection. Instances in which the garthmen and shepherds became affected were not uncommonly met with, the disease presenting in these cases symptoms similar to those presented by animals affected with the same malady.

It may be said that one attack, to a large extent, confers immunity; but, as in the case of most diseases, both among men and animals, this statement is by no means to be taken as an absolute one. Cases are known, for instance, in which animals have taken the disease twice, thrice, and, though very

rarely, even four times. However, it may be held as a fact quite free from doubt that if a disease appears more than once, it is, on the second occasion of its appearance, much less severe. Further, although many adult animals have succumbed from foot-and-mouth disease, it is not, as a rule, fatal amongst older oxen and sheep. Again, oxen have it usually more severe than it is in the case of sheep. The mortality is much higher in young animals, and the disease often assumes a very virulent type among animals which are suckling. The virus may be destroyed by means of the easily-procurable gas chlorine, and also by other germicidal agents, and, indeed, disinfectants are most potent in regard to the contagium of this disease. Chlorine is a yellowish-coloured gas, and is set free when diluted sulphuric acid is added to a mixture of salt and the black powder, dioxide of manganese.

The disease does not manifest itself in an animal directly the infection is taken, but, on the contrary, it remains latent for from one to four days before giving rise to any appreciable disturbance. Our readers are aware that there is similarly an incubatory period, which varies in length in the case of other specific fevers of man and animals, and we have already spoken of that of pleuro-pneumonia. In the case of measles in human kind it varies from seven to ten days. In small-pox the average duration of the stage of incubation is twelve days. So rapid is the spread of foot-and-mouth disease, owing to its great infectiousness, that even before any germ had been actually demonstrated it was almost certain that it had no other actual cause.

In the case of oxen affected with this malady, the temperature rises from about 101¾ degrees F. to about 105 degrees F., the animal has fits of shivering, the appetite is lost, the bowels are constipated as a rule, and the breath has an offensive smell. After about two days in most cases, vesicles, varying in size from that of a threepenny bit to that of a half-crown piece, appear in patches on the lining membrane of the mouth, *i.e.* of the inner surface of the lips and cheeks, and on the tongue, sometimes on the lips and on the schneiderian membrane, on the digits, in the case of female animals on the swollen and red teats, in which case the virus is sure to be communicated to the milk during the process of milking. These blebs are generally rounded or oblong, and are elevated above the level of the sur-

rounding membrane. In colour they are of a yellowish-white hue.

The mouth is usually so sore that food cannot be taken with any comfort, much less masticated. Sometimes the mouth is mainly or only affected, sometimes it is the feet which are thus singled out, while frequently both parts are the seats of the vesicular eruption. Especially in sheep, goats, and pigs, the feet are often invaded. The mouth, if opened, displays the presence of these vesicles, which may perhaps be of about the size of a bean or that of a hazel nut. The vesicles are never depressed in the centre, and they do not become pustular, the fluid which is contained in them being always clear. In the course of about twelve hours they usually dry up or burst, and the red and painful raw and eroded surfaces which are exposed may either soon be closed with a scale of epithelium, or, on the other hand, may lead to the formation of ulcers. When this is the case, the saliva then flows forth in still greater quantity from the mouth, and collects in the form of frothy foam around its opening. When the morbid action in the mouth is severe, a large portion of the epithelial covering of the tongue may peel off—like a glove, as it were.

One of the most characteristic of the symptoms of foot-and-mouth disease is the continual smacking of the lips, together with champing and dripping of the saliva, and of thick mucus out of the mouth. The animal grinds the teeth, and suffers much pain, owing to the wretched condition of the lining membrane of the mouth and tongue. In most cases an eruption of vesicles similar to those just described also appears on the feet around the coronets, and in the space between the claws of cloven-hoofed animals. Indeed, the structures which secrete the horn may be so greatly inflamed as to lead to the casting of the hoofs. The coronets swell, the vesicles may even extend all round, and, the inflammatory action increasing, the animal often assumes the recumbent posture, in order to relieve the pain occasioned by standing. Otherwise the animal may stand with back arched and four feet close together, reluctant to move; or may move its feet up and down even before the vesicles have appeared between the toes. There is a discharge from the eyes and nose in animals affected with this disease, those organs being inflamed.

If the animal is about to recover, the febrile symptoms subside, and begin to disappear about the fourth day, while at about the eighth day the appetite is regained and consciousness well nigh established. If the sufferer be a milk-giving cow, the secretion of milk returns to the normal point, the epithelium again grows over the eroded patches on the surface of the tongue and the lining of the mouth. On the other hand, the disease will assume a severe character if the animal is destined to die; the ulceration may spread, the hoofs slough off, and the animal become extremely prostrated, and die at about the ninth day. If this is to be the result, it is probable that vesicles will be formed not only in the mouth and on the feet, but also, and especially in the case of young animals, on the fauces and pharynx (the larynx also being irritated), the lining membrane of the eyelids, that of the windpipe, and also on that of the whole course of the digestive canal. If the intestines are affected, diarrhœa will be manifested, while, if the windpipe be attacked, a hoarse cough is often uttered. If young animals are very virulently affected, they may die even before any eruption has occurred, and after death, in such instances, the lungs will very probably be found to be highly congested. It is especially when the udder is inflamed, and when the tongue and feet are much affected that the loss is particularly great.

Puffy swellings are sometimes formed also in parts, and this, says Williams, was especially the case in the outbreak of 1872, in which the disease introduced into Edinburgh and Leith from Iceland assumed a very virulent form.

One of the worst features, however, of foot-and-mouth disease is the frequency with which it invades the udders of milch cows, giving rise to mammitis or inflammation of the milk-secreting organs. The vesicles in these cases are usually formed on the teats, but may also invade the ducts which conduct the milk from the cells which secrete it to the openings at the end of the teats. The calves contract the disease in a very bad form from the eroded vesicles on the teats, and from the milk contaminated by the unhealthy secretion from the lining of the tubes. In such cases the mortality, unless proper therapeutic and hygienic measures are taken, is apt to be very serious. Indeed, even the milk from a cow in which the udder is not especially affected is damaging to young animals.

The duration of cases of foot-and-mouth disease of average severity varies from six to fifteen days, from the day of rise of temperature to the subsidence of the fever. It will be evident that the more virulent the outbreak the greater the emaciation of the animal and the fatality of the disease. Should, however, complications arise, the disease is necessarily protracted. It is when the udder is inflamed, and when the feet are much involved, that the loss is especially great. Indeed, the loss in regard to the milk-supply is often very serious, and so also is the loss of flesh in fattened animals.

In severe cases almost complete cessation of the secretion of milk may ensue, and even in ordinary cases the quantity is diminished by one-third of the entire volume.

It has been proved that the germs cannot be destroyed by means of boiling the milk, and hence it is very clear that on no account whatsoever should the milk of cows suffering from foot-and-mouth disease be supplied for the use of human beings.

The description we have given above applies especially to oxen, but it may be taken as a fair general account of the disease. However, we now proceed to consider specially the case of sheep and goats. These animals, when attacked with the malady, become very much emaciated, lose their appetite, and manifest febrile symptoms, which are, however, usually less severe than those of cattle, albeit that the temperature may rise as high. In fact, foot-and-mouth disease, as it appears in sheep, is not in the general way so serious a complaint as it is when affecting oxen. The sheep or goat lies down at a distance from the rest of the flock, looks dull and weak, can only with difficulty be made to move on, and when walking walks unsteadily. A peculiar smacking sound is made with the lips, which the animal keeps moving, as if in the act of sucking. This is very characteristic, as, indeed, we pointed out above. The mouth is hot and full of thick saliva, and the vesicles break out especially on the incisor pad. More rarely they are seen on the whole of the lining of the mouth and on the tongue, and even on the eyes they are said to be sometimes present. In the case of these animals, however, the eruption is more frequently present on the feet than in the mouth; but actual vesicles are not usually seen. It is most generally the case that the skin around and between the claws is

FOOT AND MOUTH DISEASE.

Fig. A.

Fig. B.

Fig. A. From a microscopic specimen of an artificial cultivation of the Streptococcus in broth, after three days' growth at 36° c. *a* Diplococcus. *b* Short chains. *c* Complex chains, due to longitudinal division of the cocci of a chain.

Magnif. power about 1250.

Fig. B. From an artificial cultivation of the Streptococcus of Foot and Mouth Disease in Agar-Agar mixture of several weeks' growth. *a* Simple Streptococcus—here and there in it a coccus conspicuously larger than the rest. *b* Branched Streptococcus. *c* Streptococcus with indication of longitudinal division of the cocci.

Magnif. power about 1250.

swollen and of a reddish colour, and from it a fluid is discharged which dries and gives rise to the formation of crusts. The inflammation occurring in this part may be followed by suppuration. In short, the feet may be most seriously injured, and the ulcers which are formed may persist, and bring about great damage and loss of general condition.

Dr. Klein * has proved that the disease is due to the growth and multiplication of micrococci, which he has found in the vesicles present in the mouths of affected sheep. A micrococcus is a very minute spherical or slightly oval organism, which, like other bacteria, divides by splitting into two portions, and it does not possess any cilium or appendage by means of which movement can be effected. There are many different kinds of micrococci. The micrococcus, which is the *materies morbi* of foot-and-mouth disease, exists singly, or in dumb-bell-like pairs, or in curved chains. These germs may infect the system through the mouth, for it has been shown that warm milk from a diseased cow, if given to pigs, produces the disease in them, or they may infect the animal by the medium of the lungs. The germs can, it is said, retain their vitality for three months at the least. It has been shown that the spread of the disease varies with the direction of the prevailing wind.

Klein points out how sensitive this germ is to the action of antiseptics. This fact is of the greatest significance, because it corresponds with and corroborates our definite opinion which we shall shortly consider in dealing with the treatment of foot-and-mouth disease, viz. that antiseptics are of the highest value in the treatment of this germ disease.

All our readers may not, perhaps, be aware that the Commission instituted last year for the investigation of cholera in Spain have recently issued a report, which appears in the proceedings of the Royal Society. The investigators have discovered a fungus which belongs to a class which includes many rapidly growing and virulent parasites of the vegetable kingdom ; for, indeed, it is now universally held that germs or bacteria are to be regarded

* In the vesicles of sheep ill with this disease I find a micrococcus, singly, in dumb-bells, and in curved chains. It stains well with the ordinary aniline dyes. It grows well in milk, in alkaline peptone broth, in nutrient gelatine, and in agar-agar mixture. It is highly sensitive towards antiseptics. It does not curdle milk, although it turns the reaction slightly but distinctly acid. (*Klein.*)

as very low forms of vegetable life. It is not as yet absolutely proven that this particular germ is the actual exciting factor of the disease, but its presence in each case at varying depths from the inner surface of the intestine, and also in the kidneys and liver, points strongly to the fact that the true cause of cholera has been at length unearthed.

It would indeed be exceedingly unsatisfactory from all points of view if, on discovering so much of the actual nature of the germs of the different fevers, we were to find that man, who so long has dominated over the largest and fiercest of the beasts of the field, and the animals he has domesticated, should ever remain a prey to the attacks of these microscopic vegetable parasites. We have already spoken of the vast strides made in our knowledge of therapeutics, especially in that section which deals with the antiseptic remedies and methods, and have shown how closely linked are the sciences of human and veterinary medicine. We have spoken also of antiseptics in particular, and of the prevention of disease by hygienic measures, and of the conditions under which vegetable germs cannot thrive.

To this all-important subject we revert again to day in detailing the special treatment to be adopted in cases of foot-and-mouth disease. For although medicinal remedies are but seldom required in mild cases, yet it must be emphatically pointed out that in the last great outbreak of this disease in England many animals were lost which with a little care might have been saved. This was especially the case with suckling calves, many of which died for want of remedial measures. Also in the cases of milch-cows, the udders were in many instances left irreparably diseased, treatment not being deemed likely to be of value. It is sincerely to be trusted that we shall not yet awhile be troubled with an outbreak of this pestilence; but, should such ever be the case, it may earnestly be hoped that simple remedial measures will be adopted in all cases of young suckling animals, and in all those cases for adults which are of a severe character.

In an ordinary mild case of foot-and-mouth disease it is neither customary nor necessary to adminster any remedial agent.

Treatment.—Laxatives, such as Epsom salts, may be useful. The affected parts may be dressed with chlorine water (freshly made, since its composition quickly changes, the chlorine and the water acting on each other and forming hydrochloric acid

and hypochlorous acid), with lotion of carbolic acid, or perhaps most preferably with ointment of salicylic acid. While the mouth is sore, the food should be of a moist nature, as the pain occasioned by the devouring of hard food is apt to be great, and may prevent the animal from taking a sufficient amount of nourishment. If it be decided to give any medicine, three drachms of sulphite of sodium, or two drachms of salicylic acid may be added to the drinking water, of which the ox should have a good supply. This dose may be repeated twice daily. It is not, however, necessary to use such antiseptic agents in the mild cases, seeing that these almost universally terminate in recovery, even when no treatment whatever is adopted. Yet it is indeed probable that antiseptic medicines do materially expedite recovery.

One drachm of sulphite of sodium, or about 15 grains of salicylic acid, may be given in the drinking-water twice daily to sheep.

The feet should be well looked to. When the horn is loose, it should be removed with great care and judgment, and the sore parts should be dressed with ointment of salicylic acid or some other effectual antiseptic preparation, such as the ointment or the lotion of boric acid. The lotion of boric acid contains one part of the acid to twenty parts of water, and is easily made by adding water near the boiling point to the powdered acid. The ointment of boric acid contains one part of the acid to about six parts of vaseline or lard.

The compound ointment of carbolic acid, made of carbolic acid, iodoform, oil of eucalyptus, and lard, is also a very efficacious antiseptic ointment (vide *Gresswell's Veterinary Pharmacopœia*).

A piece of cotton wool or tow may be soaked with the lotion, or, better still, smeared with the ointment, and then spread over the affected parts. The foot should then be neatly bandaged up, so as to keep it quite free from dirt. If the mouth be very sore, a gargle made of one part of boric acid, five parts of glycerine, and eleven of water may be used to wash out the mouth several times daily. On the whole, we recommend the ointment of salicylic acid for the feet.

When an ox shows symptoms indicating much prostration, a drench containing three drachms of carbonate of ammonium and two drachms of salicylate of sodium, and one ounce of nitric ether may be given in a sufficiency of water three times daily.

If prostration be not a special feature, two drachms of salicylate of sodium, or the same amount of salicylic acid, may be given in water as a drench twice daily, or three drachms of sulphite of sodium may be given, as this remedy seems to be of great efficacy in such cases. If it is deemed desirable to do so, these remedies may be mixed with liquid food, and then administered in cases where the animal does not refuse the liquid food. The feet should be still more carefully looked after than in the mild cases, and should be kept strictly clean. They should be well washed, and then dressed with some strong antiseptic ointment. That containing carbolic acid, oil of eucalyptus, and iodoform is especially valuable. Then the foot should be carefully bound up and dressed likewise again on the following day, and so long as it continues in an unhealthy condition. In young sucking calves foot-and-mouth disease often assumes a very virulent type. This is, no doubt, to be attributed to the contamination of the milk by the diseased products, and to the direct effect of the contaminated fluid on the stomach and intestines of the young animal.

Similarly, in very severe cases of the disease in sheep, the food should be moist and nutritious, and consist of such things as linseed cake, gruel, mashes, and soft roots. If an adult sheep is severely prostrated, a drench containing 20 grains of carbonate of ammonium, 20 grains of salicylate of sodium, together with 2 fluid drachms of spirit of nitrous ether and a sufficient quantity of water may be given twice or even thrice daily. If the animal be not very greatly prostrated, 20 grains of salicylate of sodium or about 10 grains of salicylic acid may be given in water twice daily. Instead of either of these, 1½ drachm of sulphite of sodium may be given. If it is thought well to do so, these remedies may be mixed with liquid food, and put before the animal to be drunk. The feet should be well washed, and dressed with some antiseptic ointment.

If the udder be greatly affected, the lambs should be removed from the ewes, or the calves from the cows, as the case may be. To the milk supplied to each calf in the course of the day 1 drachm or 1½ drachm of salicylic acid should be added, and to that given to each lamb about 5 grains. In the case of a calf at least 20 grains of salicylic acid should be given in a little milk twice every day so long as the disease continues, even if the

udder of the mother does not seem to be affected. To the cow herself the same acid should also be administered. When the udder is greatly inflamed, the affected parts should be thoroughly fomented with hot water for an hour or two at least once daily, and the sore parts should be cleaned and dressed regularly with ointment of salicylic acid. If there is sloughing of an extensive kind, either on the feet or elsewhere, stronger antiseptic applications may be used. One part of carbolic acid to nine parts of either olive oil or glycerine, or one part of carbolic acid and one of oil of eucalyptus to 12 parts of either olive oil or glycerine, will be found exceedingly efficacious.

In addition to the above disease, which may be termed true foot-and-mouth disease, we may point out that there is a particular kind of enzoötic disease of sheep affecting especially the feet, but also the mouth, which, although resembling true foot-and-mouth disease in many points, is yet quite distinct from it. According to the late Mr. D. Gresswell, who had a very wide experience of the diseases of sheep, and also to Mr. J. B. Gresswell, this enzoötic disease, which affects especially the feet but also the mouths of sheep and lambs, causing more particularly great loss among the lambs, is very liable to be mistaken for foot-and-mouth disease. Many of the older shepherds and veterinary practitioners were very well acquainted with this malady long before foot-and-mouth disease was imported into this country about the year 1839. In many cases it seems to be due to the mechanical irritation of dirt and clay leading to erythema in the region of the coronets, villitis, and consequent separation of horn from the coronet, also to erythema on the lips and nose.

The malady occurs especially in wet and frosty weather. It is due to the continued effects of moisture, dirt, frost, varied with heat (arising from putrefaction), and often breaks out on ill-drained, clayey turnip-land, and also on wet grass-land, though to a far less extent and in a much milder form. Indeed, the piteous spectacle may very frequently be seen of sheep paddling about in fields of which the soil is simply one mass of sludge and decaying vegetable material. The dirt gets wedged between the claws, and on the lips, and there it freezes, producing not only irritation, but also what is very important, namely, undue expansion of the claws, and the inevitable result soon shows itself. Formerly the complaint of which

we are speaking was very frequently met with in the Marsh and also on the Wolds of Lincolnshire; but improved methods of management, better drainage, and greater care for the sheep are, happily, gradually removing such a distressing state of things. It is, indeed, greatly to be hoped that farmers will see that their sheep and lambs are properly seen to, especially in severe weather. The onset of the disease we are speaking of is so sudden that a whole flock of sheep may become affected in a day or two, and, indeed, it is by no means an uncommon occurrence for a shepherd in the winter-time to find that as many as 200 sheep out of a flock of about 400 or 500 have been seized with lameness, even in the course of one single night. The clay becoming fixed between the claws, freezes there; and this, together with the effects of the ice present on the land and the icy cold water and sludge, weakens the vascular structures of the parts to such an extent as to cause congestion, inflammation, and so on.

The effects of water on the hoofs are well illustrated by the following fact:—When Napoleon's army was on the march near Moscow, the weather was so wet that the horses had for some time to travel through water, and so great was the effect of this on their feet that the hoofs of many of the horses came off.

It is often the case that a great many lambs are lost in England. Much of the mortality is supposed to be due to abortion in the ewes, and without doubt many deaths are due to this cause. There have, however, been several other factors at work, and a very important one is that numbers of ewes suffering from the disease above-mentioned have—to use the shepherd's expression—laid their lambs to death. It is a fact that ewes, suffering from the above-mentioned enzoötic disease of the feet, do actually lie down on their lambs and so kill them. On one farm a hundred lambs were lost in great part from this cause, and in another case a farmer informed us that he had lost lambs worth £200, partly owing to the above cause, partly owing to skit.

Many lambs also die from the attacks of rheumatic arthritis, a disease which we shall consider in due course.

Sheep affected with this disorder have not much elevation of temperature. In fact, it is seldom above 104 deg., and very unusually does it rise above 103° or 102° F. It is important, also,

to bear in mind that beasts, if turned into the same field, do not become affected in any way, but, on the contrary, remain perfectly healthy. Again, if the affected sheep are taken to places favourable for recovery and suitably treated, being put into a dry grass field, for instance, and well looked after, they will get well, and, moreover, if healthy sheep are put with them, they will remain quite healthy.

Again, the sheep afflicted with this malady do not secrete a large quantity of saliva, nor do they smack the lips, nor is there any vesicular eruption to be seen either inside or outside the mouth, all of which symptoms are, as we have seen above, to be noted in typical cases of foot-and-mouth disease.

Before concluding, we may just briefly state the symptoms. The sheep go lame suddenly, the foot and the coronet are hot and painful to the touch, and occasionally very small scabs may be present on the nose or on the lips. The appetite is not as a rule markedly impaired. The pain which ensues from progression causes the sheep to sit and lie down. Sometimes it may be found difficult to move them, and even when they do move, they will, perhaps, merely limp on for a few yards, and then squat themselves down again. At this time the coronets, if examined, will be seen to be affected with acute erythema, while suppurative laminitis breaks out over the coronet in such an extreme form that even the hoof may come off. As for the mouth, the outside of it is sore; but the tongue is perfectly healthy, and, as we said above, there is no extra discharge of saliva.

This disease which we have described, our readers will see, is distinct from foot-and-mouth disease in various particulars, and from foot-rot in that the mouth is affected, and also that in this disease there is no ulceration of the foot like that of the contagious foot-rot, which disease we now proceed to consider.

FOOT-ROT IN SHEEP.

In due course we now come to a consideration of that important disease which is known as foot-rot of sheep. Now, at the outset, it is well to draw a clear distinction betwixt that simple kind of foot-rot with which sheep are liable to be afflicted when they are kept on wet grass-land — especially if, the

land not being well drained and the weather wet, there are many marshy places about—or in filthy yards, and the contagious foot-rot, which is a much more serious affair.

The simple kind may generally be cured by the obvious device of removing the sheep to dry situations. It begins in the interval betwixt the claws, and the formation of purulent material may spread very rapidly, and even lead to the hoof being quite undermined and even thrown off. The structures which secrete the horn, and the structures near those structures, become inflamed, soften, and split, and frequently all four feet are similarly attacked. The damage may probably have resulted from direct irritation; such, for example, as that wearing away of the sole to the quick which may easily be brought about by travelling for long distances on hard roads, or by soaking of the hoof in wet and sludge, by the effects of ice or icy cold water on the coronets, by wounds, by collection of dirt between the claws, or by the sheep standing on hot manure.

However, this non-contagious foot-rot can be easily cured, as we have said above; but the contagious form of the disease is a very much more dangerous malady, on account of its tendency to spread very rapidly from sheep to sheep throughout a district. It seems also to be most especially liable to break out in fine-woolled improved merino breeds. On the other hand, coarse-woolled sheep are not only less liable to the disease, but, if affected with it, they are also capable of being more easily cured. The virus of the malady does not seem to affect other animals besides sheep. It is communicated through the skin around the claws, and the period which elapses between the time at which the virus gets into contact with the hoof, and the period at which the disease breaks out, is about four and a half days. This virulent kind of foot-rot may be mistaken for the mild variety above described. It is not very possible to mistake a case of contagious foot-rot for one of aphthous fever, the absence of symptoms in the mouth proving that the animal cannot be suffering from the latter malady. Again, mud-balling also, in which mud, having become lodged between the toes, hardens there and sets up inflammation, is also a very distinct complaint.

On the Continent contagious foot-rot has often spread in an epizoötic manner; in Australia it is commonly met with; and in the United States it is at times very markedly prevalent

among the merino sheep, being apparently more severe in warm weather than in more inclement seasons. This contagious form of foot-rot is probably caused by a parasitic vegetable growth, and it may often begin even at the top of the hoof—in fact, at any part where the virus happens to come into contact with the hoof. When the disease has thoroughly established itself, the sheep, while grazing, may be seen upon their knees, so much pain does it cause them to put their feet to the ground. The wool is thereby worn off, and the knees will therefore be seen to be bare. The disease begins by the vascular structures of the foot becoming inflamed, and then ulcerating, and giving rise to the formation of an offensive purulent fluid, and ultimately the hoofs may come off, and the disease spread upwards into the bones. The malady is actually communicated by contagion; but long marches, lack of attention to the hoofs, rank grass, standing on manure, the entrance of dirt into the hoofs, ground which is either too wet or too dry, or hot, stony, or sandy, may be mentioned as additional factors. As a rule, only one foot is attacked at first; but the malady soon passes on to the other feet.

The earliest sign may be that one of the fore limbs is slightly lame. A day or two after this the hoofs become hot and painful, especially in the interval between the claws. In fact, the skin between the claws and above the hoof is red, and exhibits at first pimples, then vesicles, then pustules, and a foul oily material is poured out. Soon small ulcers appear, and they gradually unite, and the discharge which comes from them is yellow and sticky, and gives out a peculiar ammoniacal odour. Perhaps the first sign of disturbance is that the heels become hot, and this inflammation increases rapidly. The skin at the top of the cleft over the heels becomes in the first instance moist and red, and it presents a chafed or eroded or even a slightly corrugated look. It then becomes sore, the discharge increases, and ulceration supervenes. The inner walls of the hoof also ulcerate, and the ulcerating process may even give rise to the penetration of these thin walls. If the horn is removed, it will be seen that the connection between the horn and the fleshy sole is severed, and a very fetid or purulent matter is exuded in the crack.

In about three and a half weeks' time the hoof may be seen to be separating towards the heel. In fact, the hoof gradually comes off from before to behind, and a dark, greasy, offensive

fluid is poured out. The ulceration between the claws becomes wider and deeper, and gives rise to still greater pain than before. If the loose horn is removed, the structures beneath are seen to be red and swollen, and covered with the offensive matter above spoken of. The sheep is dull and feverish, cannot put the affected foot to the ground, in fact can only stand with great suffering, and therefore assumes the recumbent posture, or, if grazing, moves about on its knees, or even crawls with its belly trailing on the ground. Before long the hoof comes off entirely, or only remains slenderly attached. The mischief, however, does not end here; for, unless the disease is cured, another hoof may be secreted, and again thrown off.

If the hoof is not thrown off, it may grow irregularly to a large size, and be much deformed. Extensive suppuration may supervene, and gradually advance higher and higher up the leg, even involving perhaps the second phalanx. In such cases the agony may be intense, the febrile symptoms continue, the appetite be quite lost, and the animal's sufferings closed at length by death. In hot weather even more evil may be occasioned, for the fleshy sole, having become a black and swollen spongy mass of corruption, may be invaded with maggots, which, of course, greatly facilitate the process of decay. As the distressed animal lies upon the ground in helpless agony, these noisome creatures may be communicated to its sides, and set about ravenously devouring their helpless prey alive.

As a rule, only one hoof is affected at first, but the disease soon spreads to the other feet, and, unless measures are taken to arrest its progress, it may break out again and again in the same feet, and may last for even as long as a year or more before a fatal result is brought about. Even if the sheep should after all recover, bony deposits, anchylosis of joints, and deformity of the hoofs remain. If the disease is of a very intense character, the digestion being stopped, and marked fever produced, death may occur in about nine weeks' time.

The virus of the disease is contained in the exudation which is discharged from the foot and it may be communicated by the medium of grass, litter, fodder, fairs, markets, roads, sheds, or stables, by lack of cleanliness in regard to railway-trucks or ships used for the transport of cattle, or by any means whereby direct or indirect contact of any kind may be occasioned. It is not

safe to take healthy sheep to pastures which have recently been used for diseased sheep, since the discharge which is poured out from the suppurating claws gets on to the grass, and from this is communicated to the hoofs of healthy sheep. The malady is very easily transmitted from sheep to sheep. Hence public washing-pens are dangerous, especially if not in the course of a running stream, since sheep may from them easily contract the disease, or, indeed, other disorders such as scabies. If the disease is properly taken in hand without delay, the loss ought not to be great. Foot-rot may, however, exist in a flock for years, if it is neglected, and thereby serious loss may ensue, not to speak of great suffering on the part of the sheep. Moreover, one attack of this disease by no means confers immunity for the future.

In regard to prevention, in the first place we may insist upon the advisability of thoroughly draining the land. Shepherds ought to keep an eye to the hoofs of their sheep, and, if necessary, they may occasionally pare them, so that they will not readily split. Sheds used for sheep ought to be sprinkled over with lime. Pastures should not be overstocked. Sheep ought not to be allowed to be taken from infected districts to others which are free from the disease, and those which have been recently purchased ought to be kept in quarantine for about a fortnight before they are put into contact with other sheep. If any become lame, they should be isolated; and those which have been in contiguity with the lame sheep should be watched for some time, especially if they manifest heat and more sensitivity of the foot than usual, or an exudation in the interval between the claws. The healthy sheep should not go near the diseased sheep, or those which are suspected, nor should they travel by the same roads, nor eat nor drink at the same places. They ought to be examined every now and again for a week, and any which are suspected to be diseased should be isolated.

It is a wise precaution to make all the sheep, whether healthy or not, pass through a trough containing, to a depth of 4 in. or more, a solution made by dissolving 1 lb. of chloride of lime in every bucket of rainwater. This trough may be placed in such a position that the sheep pass through it once or twice each day. After the disease has been cured, all the manure should be taken away from the sheepfold, the floor of which should

either be dug up to about the depth of 6 in., or thoroughly well strewed over with lime. Moreover, all walls, mangers, and so forth should be well lime-washed, or washed with a solution of chloride of lime. The flock cannot be considered free from the disease until about six weeks after the last case of recovery has taken place. All those persons who own flocks in a district in which the disease has broken out should exercise the greatest care in regard to their sheep; but as it appears that other kinds of animals cannot be attacked, special precautions in regard to other animals need not be taken. It is possible that dogs may convey the virus.

With reference to treatment, the first requisite is that all those sheep which are afflicted should be at once picked out and placed apart from the rest of the flock in comfortable sheltered quarters well littered with dry straw, in order that they may be thoroughly attended to. The field from which they have been removed should be strewn with lime, and, if it is practicable to do so, the healthy members of the flock should be taken away to other pastures. Some practitioners would recommend that an opening drench should then be given to all those sheep which are diseased; but this is not always necessary. The feet should first be well cleansed by the help of warm water and carbolic-acid soap, especially between the claws, and then carefully examined, and if any foreign substance clings to the hoofs, it should be removed, if necessary, by the help of paring away the diseased horn, so that the diseased parts are laid bare. The horn should be pared away down to the very bottom of the disease, that which has separated from the underlying parts being carefully and gently removed with a drawing knife.

Randall gives very good directions, to some of which we are indebted. The operator sits down in a chair, having close at hand two good sharp knives, one of which should be thin and narrow, a whetstone, strong toe-nippers, and a bucket of carbolised water with linen rags in it. The assistant catches a sheep, lays it partly on its back, and holds it between the legs of the operator, so that the sheep's head is about on a level with his waist; the assistant presents each foot in turn to the operator, who then proceeds to shorten the hoof with the toe-nippers. Should there be any dirt between the toes, it is first removed with a stick, and then by the help of a rag taken from the

bucket containing a solution of carbolic acid, which is drawn between the toes to and fro, and then rinsed. Then the operator removes the diseased horn. The diseased parts of the feet should then be well dressed with ointment of salicylic acid, or with ointment of boric acid, and then poulticed for at least a day in linseed meal or oilcake poultice. At the expiration of the twenty-four hours, the feet may be well washed with warm water, and placed in a fresh poultice for another day, and then again washed and dressed and poulticed.

Some recommend the application of Stockholm tar, and where no better substitute is readily to be procured, that simple substance may be found very useful, and especially in the summer

FIG. 18.

The above picture represents the method of applying any suitable preparation such as ointment of salicylic acid, by means of a bandage or rag, to the inter-digital space.

time. Others recommend that the diseased structures should be corroded with the powerful acids, such as sulphuric acid or nitric acid. *Sulphurous Acid* is really the best for this purpose. In case any acid is applied, it is usual to do it by means of a feather dipped in the fluid. The pustules are by this means destroyed, and an eschar forms and falls off in about seven days. It is advisable then to follow up the treatment by the application of ointment of salicylic acid, or that of boric acid, or with a mixture of sulphate of copper and Stockholm tar. Sometimes, however, it may be necessary to repeat the application of the sulphurous acid, or other acid, and then follow it up with the ointment.

Some prefer to use nitric acid at first, so as to burn way the decayed and decaying tissues, and then to dress the surface

with a mixture of oil and sulphuric acid. As a matter of fact, however, if sheep are very badly afflicted with this disease, the best plan is to have them slaughtered at once. When a valuable ram or ewe is very severely affected, it may, in some cases, be wise to amputate the foot well above the point to which the disease has penetrated. The result will be that the end of the limb will shortly be covered with a thick, horny scar, and the animal will be able to graze fairly well, moving about on its other three legs.

For the diseased sheep, dry and clean situations should be selected, and it is much better to keep them under cover until they are cured, as, for instance, in a large stable with a dry floor on which manure is not allowed to accumulate. The floor should be covered with plenty of oat-straw, or with pine-sawdust or tan to the depth of about three inches. At the least the animals under treatment ought to be sheltered for a few nights, and they should not be allowed to go into the pasture for grazing until the dew is off the ground in the morning, nor remain therein until it is deposited in the evening. Muddy and damp places are especially to be avoided. As in the case of scabies, no general treatment is requisite.

TUBERCULOSIS.

There is no subject of greater importance in the whole range of pathology than the disease which goes by the name Tuberculosis. All our readers will be familiar with some aspects of the subject, and they will therefore be all the more ready to hear the latest results of research regarding this most serious scourge. This truly terrible malady occurs in many kinds of animals, and also in man; and it may attack the lungs or other organs. The word "consumption" may be applied to different forms of lung mischief; but the disease which is most generally so designated is tubercular consumption, that dread and well-known malady.

To the general public the particular form of the disease known as "consumption" is most familiar, though indeed "consumption" does not necessarily imply the presence of tuberculosis, but may arise from other forms of lung mischief. So highly important is this subject of tuberculosis, and so intimately do all questions connected with this disease in oxen bear

upon the welfare of human beings, owing to their liability to become affected with it, that we propose to deal with this important topic rather fully. Mr. Bland Sutton has recently been writing upon this dreadful scourge as occurring in birds. He affirms that it affects chiefly birds which live upon grain, and that its existence in birds of prey may often be attributed to their feeding upon smaller birds. As an illustration of this kind of causation, Mr. Sutton mentions the case of a python which died of tubercular disease of the liver, having been fed upon fowls, pigeons, and ducks, which are very liable to tuberculosis, and some of which were, it is to be presumed, certainly afflicted with the disease.

It is with some pleasure that we take in hand to discuss this most interesting and dread disease; for by the help of the researches of Dr. Klein and others we shall be able to throw some light upon it.

It may be found that bovine tuberculosis can be stamped out, as cattle-plague, foot-and-mouth disease, sheep scab, pleuro-pneumonia,* and rabies can; and there are also some indications that protective inoculation with tubercular matter obtained from fowls which have died of the disease might throw some light upon a method of prevention.

Tuberculosis is unfortunately quite commonly met with among human beings, oxen, and monkeys. The domesticated oxen over the entire surface of the globe seem to be afflicted with it. There are indications that close in-and-in breeding is at least one of the causes which may make it more general. In thickly populated districts, and especially when the climate is for other reasons unhealthy, it is more highly destructive. In Mexico the disease is so common that about 34 per cent. of the oxen slaughtered for food are said to show signs of its presence; and that in England the disorder is far more prevalent than is generally supposed, can be seen at once by inspection of the carcases of cattle slaughtered for human food. In the cow-sheds of large towns tuberculosis is very commonly met with.

The malady seems to be found more frequently in cattle than

* There are not a few persons who believe that pleuro-pneumonia cannot be entirely stamped out, because of the milder forms of the disease not being recognized in some cases, though in isolated instances it may be arrested by very vigorous measures carefully and thoroughly carried out.

in other animals. It also occurs, though very rarely, in sheep and pigs. In solipeds it is not often seen, and in carnivorous animals it is almost unknown. The disease is also met with in poultry, and it has been suggested that in some cases the infection has been conveyed to them by the medium of human tubercular sputum. Strange to say, fowls seem to be not so capable of being inoculated or infected with bovine tuberculosis, as of becoming affected with tuberculosis of a mild type if inoculated with or fed upon human tubercular matter.

The malady has been induced in many animals of different species by inoculating or feeding them for a time with tubercular matter obtained from animals affected with the disease. Guinea-pigs and rabbits may be inoculated either with human

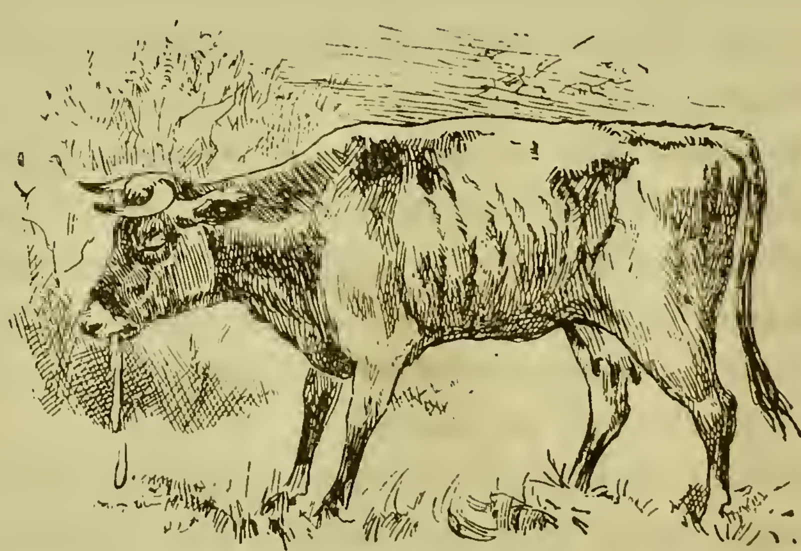


Fig. 19.

The above picture represents a cow suffering from tuberculosis. The poor cow is, indeed, a pitiful object; but how much more so is a human being when afflicted with this truly dreadful complaint, only those who have repeatedly seen them so affected can know. How earnestly, then, ought we to do all in our power to find out a means of combating this awful malady!

tuberculosis or with bovine tuberculosis; but the diseases induced in the two cases are perhaps not identical. Dr. Klein holds that human tuberculosis is not exactly the same disease as bovine tuberculosis, and it has not as yet been absolutely proved that tuberculosis can arise in man from eating the flesh or drinking the milk of cattle afflicted with tuberculosis. It has been well established that bovine tuberculosis is transmissible to pigs, cattle, sheep, monkeys, rodents, &c., by tubercular matter, and it is probable, although it has not been actually proved, that human beings can contract human tuberculosis by feeding on flesh or milk of tuberculous animals.

If guinea-pigs or rabbits are inoculated subcutaneously, or fed with either human or bovine caseous tubercular matter, tuberculosis is produced; but there are differences which show that the general tuberculosis which is produced in the case of human tubercular matter being used is not exactly the same as that produced when bovine tubercular matter is employed. Rabbits readily get bovine tuberculosis either by inoculation or by feeding, but human tuberculosis, if communicated to them, takes a slower course, and involves fewer organs, and even these are less markedly affected. Fowls, on the other hand, cannot be so readily inoculated with bovine tuberculosis as with human tuberculosis. Dr. Klein and Mr. Lingard have proved that while fowls are susceptible to tuberculosis as the result of feeding, and also as a result of subcutaneous inoculation with human tubercular matter, they appear to be much less susceptible to bovine tubercular matter, in whatever way it may be introduced into the system. Fowls may become infected with tuberculosis by taking food contaminated with human tubercular sputum.

It is very noteworthy that fowls infected with human tubercular matter were extremely well nourished, although having tubercular deposits. In the market they would have been considered "very fine." Moreover, guinea-pigs and rabbits are affected differently by the two diseases, human tuberculosis and bovine tuberculosis respectively. Guinea-pigs fed with bovine tubercular matter develop tuberculosis more quickly, and with wider implication of the viscera than guinea-pigs fed with human tubercle. Two guinea-pigs fed with the tubercular liver of a fowl became affected with tuberculosis, but the disease was of a mild character. It is possible, therefore, that by passage through the fowl human tubercular virus might be so attenuated as to admit of the idea that it might be used successfully for purposes of protective inoculation.

At least two most interesting and important points seem to have been elicited by the experiments of Dr. Klein and Mr. Lingard. One is that the tuberculosis of fowls is more of the nature of human tuberculosis than of bovine tuberculosis. The other is that human tubercular matter, used to produce disease in fowls, may undergo some loss of its infective power during its passage through the fowl. Dr. Cash has found that a restraining influence is exerted by ozone upon human and

bovine tubercular bacilli. These bacilli do not so readily kill rodents when exposed to the influence of ozone. This agent, ozone, has, however, seemed to be more antagonistic to putrefactive bacilli than to the bacilli of disease.

To those who hope for great discoveries in the region of medicine, and to those who, while knowing what great strides have recently been made in the scope of our powers over disease, whether by therapeutic appliances or hygienic measures, or other modes of preventing and combating the maladies to which animals are subject, such as preventive inoculation, look for still greater powers soon to be gained, the fact that the salt known as perchloride of mercury, or as corrosive sublimate, has the property of actually killing the bacilli of various diseases, such as anthrax and tuberculosis, will be hailed with rejoicing. Even the most pessimistic cannot but see in this recent discovery, as in many others made quite lately, that the grand march of science is nowise either less quick or less sure than in the days of Bacon, of Newton, and of other great masters. Nay, rather would we compare its onward progress to that of the children's snowball, which, unlike the rolling stone said to gather no moss, grows larger and larger, and with each successive revolution adds still a greater quantity of snow than with the last. Thus is it with science, the great lever by which human beings may hope not only to remove a great deal of the mystery wrapped up in life, but also to live in the best way possible, and so do their duty, so far as it is shown to them, for the brief space during which they are, for some unknown though doubtless great purpose, sojourners upon the face of the earth.

Before, then, we proceed to the consideration of the causes of tuberculosis, we now propose here very briefly to mention the valuable results which Dr. Klein and Mr. Lingard have quite recently obtained regarding the action of perchloride of mercury on the bacilli found in tuberculosis. A solution of this salt in the proportion of 1 part in 960 parts of water completely destroys the infective power of the virus of human tubercle, if this is exposed to it for from four to eight hours. If bovine tubercular matter is exposed to the action of the same solution for five hours, and if then tuberculosis is produced by the matter so acted upon, there is a marked retardation of the disease. In one case exposure to the solution for eight

hours destroyed the infective power of the virus, and nine hours' exposure destroyed the virus in both the cases which were tried. The bacterial fluid added to the solution of the mercuric salt was in the proportion of 1 of the former to 100 of the latter.

The above-mentioned observers arrive at the conclusion that both the restraining and the killing powers of this salt are far greater than those of any other known chemical substance. Speaking generally, they hold that organisms which do not produce disease are less strongly affected by the salt than organisms such as the anthrax bacillus and the tubercle bacillus, and other bacilli which produce disease.

Causes.—Tuberculosis is, as our readers are probably aware, characterised by the deposition of tubercular matter in different parts of the body. The lungs, intestines, liver, spleen, lymphatic glands, or other organs may be affected. As a result of the disease, the tissues waste, and death may occur more or less rapidly. Now the question naturally presents itself, "By what means are these changes brought about?" This question can now be answered far more clearly than was possible a few years ago; but even in these days of scientific exactitude the word "cause" can only be used in a provisional sense. There are yet many points admitting of considerable doubt in regard to the causation of disease, and we do not say this so much from the philosophical point of view, as from the stand-point of the practical man. Owing to the recent improvements in that most useful instrument of scientific research, the microscope, the observer of this age has been introduced rather suddenly into new worlds teeming with rich stores, and the mines of wealth open to exploration are so immense that as yet we have not had time to devote to this all-important question of "germs" anything like that attention which it deserves.

Tuberculosis may be said to depend upon the presence of tubercle-bacilli in different parts of the body of the animal which is affected with it. The bacilli of tuberculosis were first found by Koch, and the form and general character of these bacilli may be seen from an inspection of the diagram on the next page.

Bacilli, so much like these as to be scarcely distinguishable from them, are present in the caseous tubercular deposits in cases of tuberculosis in man, cattle, monkeys, and birds, and likewise

in animals in which the disease has been artificially produced, either by inoculation, or feeding, with tubercular matter in the case of cats, guinea-pigs, rabbits, fowls, and rats. They are also found in the blood in acute miliary tuberculosis of man.

Many deposits which have been but newly made do not show the presence of the tubercle-bacilli; but it is possible, of course, that they or their spores in such cases may have escaped detection. These tubercle-bacilli are different from other bacilli; but as regards their chemical constitution they are not unlike the bacilli of leprosy. If these bacilli are found in the sputum of a patient, the presence of the disease may be said to be

Fig. 20.

From a preparation of human tuberculous sputum, stained after the Ehrlich-Weigert method. The nuclei in the specimen were stained blue, the tubercle-bacilli pink. Magnifying power 700. After *Klein.*

established beyond all possibility of doubt. Some of the bacilli look smooth and homogeneous, while others are more beaded in appearance.

The bacilli are most numerous in the caseous masses found in the lungs of affected oxen. They do not move about, and they are said to contain frequently bright oval granules which may be spores. It is very probably owing to the presence of these spores, if spores they be, that human sputum and other tubercular matter retains its virulence, even after drying. It has been thought that such tubercular matter may dry and crumble, so that the germs of the disease may be driven about by the wind,

and so produce tuberculosis in animals subjected to it. Koch cultivated the bacilli outside the body, and by dint of great care succeeded in isolating them. The bacilli thus obtained, when inoculated into suitable animals, always produced tuberculosis.

If these bacilli are injected into the tissue under the skin, or into the peritoneal or pleural cavity of guinea-pigs and rabbits, there will be produced after three, four, or more, weeks, a swelling of the lymphatic glands near the seat of the inoculation, and these glands will subsequently caseate and ulcerate, just as

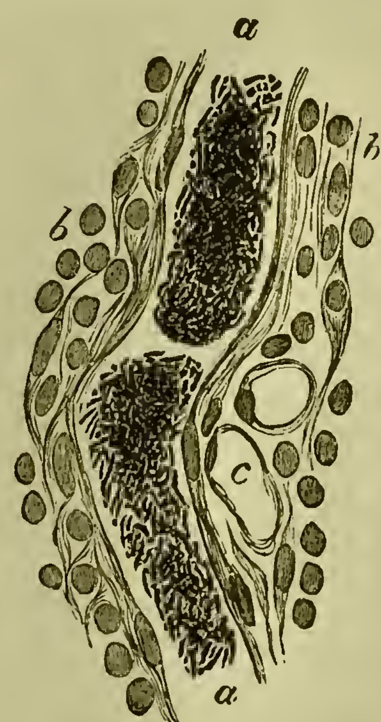


FIG. 21.

The above picture is a representation of the microscopic appearance presented by a section of a portion of the kidney of a rabbit which died from the effects of Artificial Tuberculosis. (*a*) Blood-vessel filled with caseous matter, and in it numerous tubercle-bacilli. (*b*) Nuclei of cells of the tuberculous new growth. (*c*) Capillary vessel cut transversely across its lumen. Magnifying power 700. After *Klein*.

they would do, if they were affected with the disease in any other way. The spleen also is enlarged by the growth of numerous tubercles. The liver also is seen to be mottled by whitish points and streaks, which afterwards merge and become caseous. The peritoneum and bronchial glands are also attacked, and the lungs show isolated tubercles which are at first grey and transparent, and then become caseous in the centre.

It has been suggested that if the germs of typhoid fever are inhaled, from drain-pipes or otherwise, the disturbance set up commences in the lungs, while if the source of mischief has entered the system by being swallowed, the first signs of the

disease will be set up in the intestinal tract. Our readers will remember that in dealing with pleuro-pneumonia we pointed out that the germs of the disease enter the system by the lungs, and that these organs are chiefly affected. If the germs of the disease are introduced into the tail, as in preventive inoculation, the lungs are not affected, though probably the micrococcus is distributed to all parts of the system. Similarly in tuberculosis, we find that if the disease is induced by feeding an animal with

FIG. 22.

The above illustration represents the microscopical appearance of a section taken from the same kidney as that from which the section represented in the preceding picture was taken. (*a*) Large artery filled with caseous matter, and in it numerous tubercle-bacilli. (*b*) Coat of artery. (*c*) Nuclei of the tuberculous new growth. (*d*) A Malpighian corpuscle. Magnifying power about 500.

tubercular matter, the organs which are first affected are the intestines themselves, and that the infection gradually spreads until at length the lungs are attacked. We have just seen above that if the tubercular virus is introduced by inoculation, the lymphatic glands near are first affected. If the disease is propagated through the air, *i.e.* by breathing the germs, then the lungs seem to be first affected, just as we should expect.

These tubercle-bacilli require a temperature as high as 38° C., and hence they cannot thrive in the outside world, as some disease-producing organisms do. Dr. Klein, one of the greatest authorities on all questions relating to germs, states that the bacilli of human tuberculosis are larger than those found in cases of bovine tuberculosis, and in many instances they seem to be more regularly granular. The bacilli found in human tubercular sputum are at least one third as large again as those found in the caseous masses of the lungs of cattle. Moreover, the tubercle-bacilli of oxen are always contained in the cells, and only when these disintegrate, as they do sooner or later, do the

Fig. 23.

From a section through a tubercle of the lung from a case of Acute Miliary Tuberculosis in a Child. Several Alveoli are seen filled with *débris*, in the centre of which are seen numerous nuclei, and amongst them the tubercle-bacilli. Magnifying power about 350. (*Klein.*)

bacilli become free in groups. In this respect they are like the bacilli found in leprosy. In man the tubercle-bacilli are always scattered between the cells.

It will doubtless be remembered that fowls seem to be not readily infected with bovine tuberculosis, possibly because they, being so much mixed up with oxen, have become thoroughly used to the disease, so that the virus has lost its poisonous properties. On the other hand they do take human tuberculosis, though in a mild form. Guinea-pigs, on the contrary, are more liable to suffer from being fed with bovine tubercular matter than they are from being fed either with human

tubercular matter or with tubercular matter obtained from fowls. There are other points of difference between bovine and human tuberculosis to which we shall refer.

In cases of tuberculosis there are tubercles in various stages of growth which, so far as can be seen, contain no bacilli. Quite near these, other tubercles may be present in which numbers of bacilli may be found. Now, it has been proved by Dr. Klein and Mr. Lingard, working in co-operation, that tubercular matter in which neither bacilli nor spores of bacilli can be detected does produce tuberculosis when it is injected into healthy guinea-pigs. The well-known deposits were found in the lungs, liver, spleen, and lymphatic glands; and some of them were caseous and contained tubercle-bacilli. As these observers remark, it is probable that spores or bacilli were present, although they could not be detected. This shows that there need not be many bacilli introduced, in order to cause the disease, and it possibly indicates that spores of the bacilli exist, and that they are sufficient to produce the disease. At present, however, it seems that there is no known method of staining spores of tubercle-bacilli, if such spores exist, as in all probability they do.

There can be no doubt that tuberculosis is capable of being propagated from the parent to the offspring. The taint of this dread malady can sometimes be observed in several members of particular breeds. Cows, and especially milch-cows, seem to be most frequently affected; and there is no doubt that dark, filthy, and badly ventilated, ill-drained, dwellings aid the progress of the disease. It is said that the chief indirect causes are prolonged and excessive milking on the one hand, and on the other a cold and damp atmosphere. Oxen brought from a milder country, or from mountainous regions, when transferred to cold and damp districts, and likewise cattle which are used solely for dairy purposes, and especially those which are kept for this object in large towns, and give an abundance of milk, are most liable to the disease.

Course of the Disease.—Tuberculosis, as is well known, is generally a disease which is not rapidly fatal, but one which lasts often for a considerable time. This statement, so far as is known, applies to all the different kinds of animals liable to be affected with this malady. Unless complications arise, tuber-

culosis may be protracted for months, and even a year may elapse before the symptoms become marked. Indeed, cattle which would not have been suspected to suffer from the disease during life are often found after death to have tubercles in their lungs and other organs. If a severe cold is taken by an animal afflicted with this insidious disease, and sometimes from other causes, bovine tuberculosis may suddenly become acute.

Occasionally the veterinary surgeon may be called to investigate and treat an outbreak of more than ordinary virulence. He may have, as Mr. J. B. Gresswell had recently, a valuable herd of Alderneys under his care. In this particular instance the malady took a form so severe that three animals died, while three cows recovered under treatment, and two more were subsequently affected dangerously. As is usual, the animals were extremely weakened with the ravages of the disease, and they suffered greatly from diarrhœa, the feces being of a creamy consistence. This last symptom was found to be associated with, and explained by, the presence of tubercular deposits in the bowels. The lungs and intestines, indeed, were the organs which had been especially attacked.

For purposes of convenience, the symptoms of average cases of bovine tuberculosis may be spoken of as occurring in three stages.

First Stage.—Though the ox, when attacked with the disease, is less active and more sensitive to pressure, especially in the regions of the withers, back, and loins, fattening and the secretion of milk are not at first interfered with. The milk is more watery, of a bluish tint, and while it contains less quantities of nitrogenous matters, of fat, and of milk-sugar, which are the nutritive elements, it is rich in alkaline salts and other mineral constituents, particularly if the cows receive much grain and bran or meal. The animal may give utterance to a dry and deep but feeble cough. This will be noticed perhaps when the ox passes either from a colder to a hotter atmosphere, or from a hotter to a colder air, as in leaving or entering its stall. A similar cough may follow exertion, or it may be brought on by compression of the windpipe far more readily than in the case of a healthy animal.

At this early period of the disease there is seldom any expectoration or nasal discharge. If the lungs are affected, as

in all probability they will be, tapping with the fingers on the chest-walls will cause the animal to give a slight grunt of pain. If the ear is applied to the sides of the chest, the gentle and regular respiratory murmur, which is heard in the case of a healthy animal, is found to be replaced by harsher, louder, and more rasping sounds in certain parts. The animal may be lame, first in one limb and then in another. Some of the superficial glands, for instance, that salivary gland which is called the parotid,* because it is near the ear, and also those lymphatic glands which are situated in the groin and arm-pit, are markedly enlarged. This first period or stage of the disease may last for months; but a sudden chill or severe hardship of any kind may rapidly usher in the symptoms of the second stage.

Second Stage.—The signs mentioned above are now intensified. The animals are emaciated and sluggish in their movements; they have a dull look, and the eyes are drawn back into the orbital cavities. The skin is dry, that which covers the ribs is closely adherent to them, and the hair lacks its healthy lustre, and is often damp. Indeed, a slight amount of exertion produces sweating, laborious breathing, and great distress. The weakness may be so overpowering that the animal may try to obtain relief by lowering its head even to the ground. The lining membranes of the mouth and other orifices are pale yellow in colour. The appetite is capricious and smaller than in health, and the function of digestion is irregularly and weakly performed, so that, after the animal has been feeding, the stomach may be more or less blown up with gases, an occurrence which is not uncommon in the ox, and not very serious, because it can be easily relieved as a rule. Constipation and diarrhœa may alternate.

The milk is now diminished in amount as well as of inferior quality. Moreover, cows which are in calf nearly always abort, and this may cause death, while, even if the act of parturition takes place at the proper time, it enfeebles the parent, and the calf is sickly and likewise afflicted with tuberculosis, the same disease as that from which the cow itself is suffering. The cough is more persistent, and the animal expectorates a viscid, usually inodorous, but sometimes offensive, matter, which may contain yellowish cheesy flakes. The breathing is quicker and interrupted.

* From παρὰ, "beside," and οὖς, "the ear."

If the chest-walls are subjected to careful and skilful percussion, dull sounds are produced in some parts, while other regions will give the same resonance as that which is produced in the case of a healthy animal. Similarly, if the ear is placed in direct contact with the chest, the observer will note that the "respiratory murmur," which he is probably acquainted with as occurring in a healthy animal, is louder than usual in some parts, and dull or absent in others. This is because the healthy portions of the lungs are, so to speak, trying to do the whole work of respiration, which in the normal state the healthy lungs were accustomed to do. In addition to this, there may be heard hissing and bubbling sounds.

In some cases the cough may be feeble and dry, and then crackling sounds, together with a harsh laryngeal blowing, may be detected. The heart beats strongly, but the pulse is nevertheless small and thready. The parotid glands, which are situated below and beneath the ears, and have, in common with other salivary glands, the function of secreting some of the salivary secretion, are more swollen than before. The superficial lymphatic glands are also still more markedly enlarged, and they, perhaps, together with other hardened painful swellings, cause lameness, which is no longer flitting in character, but constant. The ox may suffer from intense fever, sweat profusely, and breathe with the most extreme difficulty.

Third Stage.—All the above symptoms are immensely exaggerated. The emaciation is excessive, and there is great debility accompanied by intense fever, which lasts during the whole day with but a few hours' remission. The cough is distressing, the back is arched, the head is low and protruded, the mouth partially open, and the tongue pendulous. The horns, ears, and limbs, are cold. Breathing is accompanied by moaning, and the inspirations are irregular and gasping. The animal suffers from a dark and fetid diarrhœa, and the rumen is considerably blown up with the gases which are disengaged, as the result of the arrest of digestion. The distended rumen can be felt in the left flank, and it adds to the poor animal's distress. Percussion on the chest gives rise to pain, and, if the observer places his ear in contact with the chest-walls, hissing and cavernous sounds are heard in the lungs, and there are gurgling sounds in the larynx. The lining membranes of the mouth and other orifices are very

pale. The action of the heart is tumultuous, and the pulse is well nigh imperceptible. There is often dropsy of the dependent parts, and sometimes, though rarely, ulceration of the joints and glands. The disease in the second and third stages may be complicated by inflammation of the lungs or of the pleuræ, which latter may be due to perforation of the serous membrane of the lung, and thus death may quickly ensue.

POST-MORTEM APPEARANCES.—If the body is examined after death, tubercles are seen in various parts. These are found in the external portions of the lungs, and in the connective tissue beneath their lining membranes, and in that which divides the lung-tissue into separate lobules. Large portions of the lungs are replaced by the tubercular matter, and they may weigh as much as 60 pounds. Tubercles are found in the lungs, pleuræ, lymphatic glands, and other organs. Many tubercles are often massed together; but each tubercle itself, the essential element in

FIG. 24.

From a preparation of caseous matter obtained from pulmonary deposits in Bovine Tuberculosis. Magnifying power 700. (After *Klein.*) The tubercle-bacilli are seen crowded within two large cells, and also scattered between them as a result of the disintegration of other cells.

this disease, is a small, round tumour, which is at first semi-transparent, but may afterwards soften or calcify. It is generally spherical, and of about the size of a grain of millet, or hemp-seed. The larger so-called tubercles, spoken of as being as large as a walnut or larger, are in reality aggregations of the smaller ones. Each tubercular mass can only with difficulty be crushed or separated from the surrounding tissues, from which it is not marked off by any definite wall. A tubercle, though itself non-vascular, is yet placed near a small artery. At first it is, as we have said, semi-transparent; but it afterwards becomes yellowish and opaque.

When a tubercle is broken up, and inspected with the aid of the highest powers of the microscope, five or even more giant-cells provided with nuclei, and smaller cells, also with nuclei, may be seen. These giant-cells are roundish and transparent, and their oval nuclei, which may be as many as forty in number, are arranged around the inner surface of their circumference. These cells may be about 1-200th of an inch in diameter, and seem to have no cell-wall. The nuclei are not acted upon by acetic acid, and each is said to be provided with a bright nucleolus, which latter, however, is not seen in the above figure. These giant-cells are easily destructible, and hence there may be many free nuclei, the number of which is great in proportion to the rapidity of the disease. In each of the above figures the tubercle bacilli are well seen.

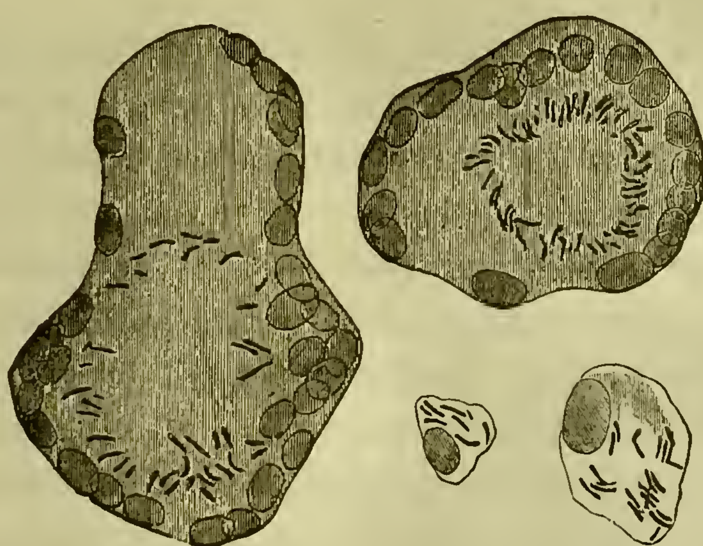


FIG. 25.

From a section through tuberculous deposits in the lung of a cow. Two giant-cells and two small cells, all containing tubercle-bacilli, are seen. Magnifying power 700. (After *Klein.*) In each of the two giant-cells the tubercle-bacilli are seen to be arranged in a circle.

Our readers will not be surprised that we have laid especial stress on this most serious disease. It will be readily seen why, on coming to tuberculosis in our list of diseases of the ox, we resolved to treat the subject in detail. Not only is it the case that large numbers of the cattle in this country are carried off annually by this insidious and death-dealing, yet interesting, malady ; but it is also true that great damage is liable to result to the oxen of England by a tendency which, one may think, only requires pointing out in order that it may be guarded against—we mean the breeding from diseased cattle. There is

no doubt that a great deal of the bovine tuberculosis which exists is due to this avoidable cause, and it is equally indubitable that a similar course of action also leads to a most objectionable result in the case of horses, namely, the prevalence of "roarers."

We have, in the first place, to complete our account of the changes which have taken place in the case of oxen which have died of the malady we are discussing. After death the tubercular deposits can be examined, and thus we are enabled the better to understand the nature of the disease. It has been found that the centre of each tubercle of a human being is taken up by small, round, wrinkled, granular, cells, which are not present in bovine tubercles. This point of difference, however, does not make us quite certain to what extent we ought to consider human tuberculosis as different from the closely similar disease of oxen.

Inside the tubercles there are no blood-vessels; but around them and in the interstices of the masses of tubercles these channels by which they, like all other structures, normal or abnormal, are supplied with new material are fairly numerous. The tubercles themselves, therefore, never become large, but they are continually surrounded by newly-formed ones, and the tubercular masses thus produced may at length weigh several pounds. The student of comparative pathology will recollect that, in this matter of blood-supply, tubercular masses are to be distinguished from the class of malignant tumours known as "sarcomata."

Tubercles may become impregnated with earthy matter, and when thus *calcified* they are like little yellowish stones about as large as peas; and if crushed, they resemble pieces of chalk. If cut through, a larger petrified portion in the centre is seen to be surrounded by a fibrous layer on the outside. The earthy matter consists mainly of the insoluble phosphates and carbonate of lime, together with a small quantity of soluble salts of sodium.

A tubercle, before it is calcified, contains mainly albumen, with a little fibrin and fat. Now, whether the tubercles do or do not calcify, they frequently soften and become *caseous*. This softening begins in the centre, and travels towards the circumference of the tubercle. If *calcification* preceded the softening, the matter in the centre is found to be white, and to

contain earthy material. If softening has come on without previous calcification having occurred, then the central portion of the tubercle is cheesy, and of a greyish yellow colour, and contains only small grey granules of fat, which are transparent in the centre and soluble in ether.

The lining membranes of the lungs (the pleuræ) are thicker, and more richly supplied with blood than is usual, and, like other serous membranes, they may have tubercular deposits upon them. At first these are very small, but finally they may be like clusters of grapes, weighing as much as fifteen pounds, and suspended by peduncles containing blood-vessels. The tubercles on the surface of the clusters are those which have been most recently formed; next to them are the calcified ones, and most internally situated are those which are oldest and have become caseous.

In cases of human tuberculosis, tubercles are found in the midst of the texture of the lymphatic glands. In oxen the tubercles are found in the connective tissue near these glands, but, it is said, never in them. When thus enlarged, the bronchial lymphatic glands in oxen may measure even a foot in length, and weigh about eight pounds. Tubercles are seen also quite close to other lymphatic glands, and often in the liver, spleen, and kidney, and in the intestines, uterus, and udder, but seldom in the muscles and bones. There may be abscesses in the lungs. The muscles of an animal which has suffered greatly from the ravages of the disease are pale and soft, and the blood also is of poor quality.

Diagnosis.—An ox attacked with the malady has a dry and persistent cough, and its breathing is accelerated even during rest, and especially immediately after exercise. The lymphatic glands are found to be swollen, and the course of the malady is as above described.

Treatment. — We have mentioned above that corrosive sublimate has been found to possess the power of destroying certain kinds of bacilli. Unfortunately this powerful salt of mercury is not only a deadly poison to bacilli; but it may, unless used with the most excessive care, and in infinitesimal doses, destroy the higher animals and man. Nevertheless, the substance has been used successfully, and can be employed with safety by the skilful specialist in extremely minute doses, the

effects of which need most patient watching and attention. We are glad to hear that it has been given in cases of anthrax in a man with encouraging results. Of course it would be madness for any unprofessional or unskilled person to prescribe or use dangerous drugs. We contend that a man might quite as well try to navigate a ship over the trackless ocean as to rush impetuously and blindly (unequipped with special knowledge) into the treatment of disease.

The healing art is one which at first sight may, perhaps, appear to the ordinary observer, to be not a very difficult one. Herein lies great danger. A long course of study and patient research is required to obtain ability to doctor either animals or man with success. The destructive effect of corrosive sublimate on the bacilli found in the disease called anthrax, on the bacillus septicæmiæ of guinea-pigs, on the streptococcus of foot-and-mouth disease, and on the bacilli of tuberculosis, has been proved. Those vegetable organisms which do not give rise to diseases in animals seem to be less markedly affected by the poisonous action of this salt than do those which cause disease, such as the bacilli just mentioned.

The treatment of tuberculosis has as yet been generally unsuccessful, and it is for this reason, and because it is of the highest importance that a remedy should be found, that we are laying some stress on this recent work. It will, no doubt, be soon recognised among medical men that both for human beings and for animals at death's door from anthrax, tuberculosis, or septicæmia, this salt, the perchloride of mercury, in infinitesimal doses, should certainly be considered and in some cases tried. Throughout the world, these facts, as yet by no means generally known, will soon be spread, and we must soon hear more regarding them, probably in confirmation, but yet possibly in refutation.

Many of our readers are aware that the gaseous substance, "ozone," is what is called an allotropic modification of the gas "oxygen," the difference between the two gases consisting in the fact that there is an alteration in the arrangement of the constituent molecules of which both gases ultimately consist. Oxygen is the most important element contained in the air. On its presence animal life depends, and the purpose of breathing is, on the one hand, the inhaling or drawing in of this gas

"oxygen," by which the various tissues and organs of the body are kept oxygenated and active, and on the other the expulsion of carbonic-acid gas, which is poisonous to animal life. Now oxygen seems to be favourable to the growth and activity of bacilli, while, strange to say, its more active modification, ozone, seems to have a distinct retarding effect upon them. This latter agent, then, may hereafter prove to be of great value in combating germ diseases. For some time it had been thought possible that this peculiar gaseous substance might have some of that germicidal power of which we have now some evidence.

Ozone is more active than oxygen. It has greater oxidising powers. In pure air small quantities are found, and it also exists naturally in greater amount in sea-air. It is supposed to be formed, in part at least, by the electric discharges which take place in storms, and there is no doubt that the reason why it is not found in the air of cities is that such air contains much matter which is readily oxidisable, and so the ozone is very soon decomposed. Its presence in sea air is no doubt one of the reasons why sea voyages often do so much good to those who are weak or debilitated with disease.

Recently Dr. Cash has confirmed the results of other investigators in regard to these two gases. He finds that oxygen has not been observed to destroy bacilli, but, on the contrary, that during the process of adding oxygen a considerable increase in the rate of multiplication of the bacilli was brought about. The reverse is the case with regard to ozone. It had been found by Binz that the chief action of ozone is a soporific one, and it has this effect, even when present only in small quantities. Hence we may explain that drowsiness which people feel when subjected to the influence of sea air. In larger amounts ozone may bring on bleeding from the lungs and bronchial catarrh. Different observers agree that the bacilli which produce putrefaction are destroyed by ozone, but that this agent has no action on the "spores" of the bacilli.

Dr. Cash has found that if about ·00267 gram. of ozone is introduced into the quantity of anthrax virus he used for inoculating animals, the virus is destroyed; and with his careful experiments he seems to have established the facts that ozone gradually weakens and ultimately destroys the virus of anthrax, but that it has no destructive effect upon the "spores." Now

tubercle-bacilli seem to have a greater resisting power to ozone than anthrax-bacilli ; and though ozone has not been shown to destroy the tubercle-bacilli, it seems to have retarded their growth and to have diminished their virulency. These experiments might well be extended.

In the case of an ox afflicted with a mild attack of tuberculosis, the best course is perhaps to fatten and then slaughter. In the case of cows it is well to cease milking, to give fattening food, such as oil-cake and good hay, and to avoid grasses and roots, as these are more difficult to digest. If there are scrofulous glands which are ulcerating, they should be dressed with some antiseptic, such as a mixture of carbolic acid and chalk.

It has long been known that a warm and equable climate is favourable to patients suffering from this disease. Men who are tainted with it, and who could not live in England, will survive for years at the Cape or in South America, for instance near Buenos Ayres. Arguing from the experiments spoken of above, small doses of perchloride of mercury, prescribed most carefully by the experienced physician, are indicated. A sea voyage, or even the supply of ozone in the house, together with plenty of sleep, a nourishing diet, combined in certain cases, and if necessary, with small doses of alcoholic stimulants, are to be enjoined.

THE CONTAGIOUSNESS OF TUBERCULOSIS.—Rabbits, guinea-pigs, calves and young cattle, pigs, sheep, goats, and a porpoise have all been subjected to tuberculosis by feeding on tubercular matter from the ox. Inoculations on flesh-eating animals with tubercular matter as a rule give negative results, but the dog has been inoculated with tubercular matter obtained from man. Feeding carnivorous animals, such as the cat and dog, on tubercular matter from the ox has no effect, probably because they have been accustomed for long ages to feed on all kinds of flesh, and their systems have become capable of resisting the action of various kinds of bacilli, not unfrequently met with in their food, perhaps as a result of that natural law of which we have heard so much, survival of the fittest. Probably this statement may hereafter require modification, for Klebs has accidentally produced the disease in a dog by giving it the milk from a cow in the last stage of the malady.

As we have implied, tuberculosis may spread from one animal

to another through the medium of the air. More than this, the stalls and sheds in which tuberculous oxen have been housed, unless most thoroughly cleansed and disinfected, will give rise to the production of the malady in healthy cattle afterwards placed in them. Tubercular sputum which has been dried for twenty days or more will, if inoculated into healthy animals, give rise to the disease. If thoroughly boiled, tubercular matter seems to lose a great deal of its power for mischief. Mr. Laws has recently found that, if exposed to a temperature of 45° C. for twenty-four hours, the anthrax bacillus is completely destroyed, and that if the temperatures varying from 43° C. to 45° C. are employed, there seems to be a loss of power in the bacilli themselves, and also in those which are generated from them. Ere long more will be known respecting the action of heat on the micro-organisms attendant upon disease. Alcohol also has been said to have a retarding influence upon the tubercular virus; but this statement certainly requires confirmation. Speaking roughly, we may say that the period of incubation of tuberculosis is about six weeks.

Cattle which have any tendency to the disease should not be used for breeding purposes, and those which are actually suffering from tuberculosis should in the first place be isolated, so that the malady may not spread. If very slightly affected, oxen may be as quickly as possible fattened and slaughtered, and their flesh, *if free from local disease*, may be utilized. We agree with others, of whom the chief in this country is Dr. Fleming, in strongly asserting that, if the disease is advanced, it is not safe to use the milk or the flesh of tuberculous oxen. Certainly any part of the body in which tubercles are actually present should be avoided like poison. Yet it is thought to be not practicable at present to be very stringent in regard to using the flesh of tuberculous animals. There are few oxen which have been kept for some time in cowsheds, and fed and milked in the ordinary way, which are not tainted with the disease. Of course the danger is the greater in proportion as the dwellings and general management are bad. No one could countenance the use of the flesh of cattle suffering from the advanced stages of tuberculosis.

It may be said (although it has not been definitely proved) that human tuberculosis can be produced by eating tubercular

flesh ; it is at least very probable that it can arise in this way. The differences between the two diseases, human and bovine tuberculosis, seem to be very slight; and even if it could be proved that they were essentially dissimilar, it could not be contended that there was not great danger of some disease arising from eating the flesh obtained from cattle in which the tubercles were soft, and in which marked signs of bovine tuberculosis were present. In any case thorough cooking of meat cannot be too strongly insisted upon. The danger of damage to the constitution, if this precaution be carried out, is far less, since in this way many sources of harm are rendered innocuous. This holds equally with regard to tuberculous flesh as to any that is unhealthy, whether from parasites or from the fact that the animal whence it was obtained was suffering from disease of any kind whatever. Hence all meat should be most thoroughly cooked as a safeguard against many different diseases and disorders.

If it has been decided to use the flesh as food, great care should be taken to remove all the affected tissues and organs. The flesh of tuberculous animals is watery, pale, and the tissue which binds the muscles and organs together is more or less infiltrated with serum. The fat is yellow and pulpy, and likewise infiltrated with serum. The marrow of the bones is soft, and looks unhealthy. In the case of a tuberculous ox which has been slaughtered and dressed by butchers, there may often be seen traces of attempts at removal of the tubercles from the pleura on the ribs. The pleura, if affected, is often removed, but one or two small calcified tubercles may be seen in the first intercostal space, and at the attachment of the ribs to the sternum.

It is not safe to use the milk of tuberculous cows. Rabbits, guinea-pigs, and even a dog have taken the disease from drinking the milk of tuberculous cows. Indeed, the milk, unless boiled, is as dangerous as the flesh. Burning of milk during boiling must be carefully avoided. If due precautions are taken, milk can be boiled without being burnt. The disease, when brought on in this way, begins as intestinal catarrh, and then gives rise to tubercles in the mesenteric glands, then in the liver and spleen, and at last in the thoracic organs. The virus cannot be destroyed by ordinary cooking. Whether or not tuberculosis can be produced by drinking the milk of tuberculous cows, there is no doubt that a child with no tendency to the disease may get

it through the milk of the mother or nurse, if either be tuberculous. We should most stringently prohibit the use of milk taken from tuberculous cows, and especially should the greatest care be taken that infants should not be supplied with milk from either mother, nurse, or cow, if suffering from the insidious malady known as tuberculosis.

The marrow, especially the red marrow, of bones, bears an intimate relation to the blood, being, in fact, the chief source from which the red blood discs are derived. In many constitutional diseases the marrow of bones becomes seriously implicated. Dr. Klein and Mr. Lingard examined the red marrow at the end of the tibia and femur of a number of guinea-pigs which had been inoculated either with human or bovine tubercular matter, and they found that it is in the marrow that the earliest manifestations of induced general tuberculosis are to be detected. As early as fourteen days after inoculation, the marrow of the tibia and femur was in all cases found to contain small irregular yellow spots, which were seen by the microscope to be tubercles in the stage of caseation, tubercle bacilli being present in them singly, in pairs, or in aggregates of three or more together. Hence it is seen that the marrow of long bones is the first tissue which becomes the seat of the general infection in cases of induced tuberculosis. Moreover, a large number of guinea-pigs having been inoculated in the usual way with such marrow crushed and distributed in well-boiled salt solution, all of them became affected with general tuberculosis.

Muscles taken from all parts of the bodies of animals affected with general tuberculosis in various advanced stages were examined, and they were found to be free from tubercle and tubercle-bacilli, with the exception of those muscles which were in close proximity to the seat of inoculation.

Subcutaneous inoculation of guinea-pigs with tubercle leads to the enlargement and caseation of the nearest lymph-glands, and then to the purulent disintegration of them, whereby an open discharging sore and abscess is established at or near the seat of inoculation. This may occur after a few weeks or more. Now it was only those muscles which were situated immediately around these abscesses which were invaded with tubercle-bacilli; in fact this muscular tissue had become generally involved in

the process. All muscles distant from the primary seat of infection were found free from tubercle and tubercle-bacilli.

The disease known as tuberculosis is at once one of the most interesting and the most important of all the numerous maladies which affect mankind. As yet, we may say, but little is known concerning the causes of the occurrence of tuberculosis, and concerning the therapeutic methods by means of which the insidious ravages of the tubercle-bacilli can be arrested. Nevertheless, of late years we have acquired the power and the knowledge which are needed for a much more far-reaching investigation of this disease, and all other diseases, than men have heretofore found to be possible. Those of our readers who are most fully aware of the truly terrible dangers connected with the disease which we are now considering will also be those who will most clearly realise the pressing necessity which exists for grappling with this subject in all its bearings, and the need for finding out, in regard to it, all that can possibly, by any human skill and research, be learnt. Indeed, tuberculosis is an awful disease, and we may all well pray most earnestly that we may escape from such insidious dangers.

As we have said, we now, in these days, know a great deal more about tuberculosis than was known some few years ago. At least, several facts and inferences may be adduced as the results of recent investigation. Of these, perhaps, the most important is that milk should not be drunk without having previously been boiled, on account of the liability of its being a means of propagating various diseases, such as tuberculosis. There is but very little doubt that the malady is, in large measure, propagated by the medium of milk, which fluid is also in many cases responsible for the transmission of other diseases of hnman beings, such as scarlet-fever, diphtheria, typhoid-fever, and so forth. Milk ought always to be boiled, since it is probably as dangerous to drink milk which has not been boiled as it is to eat meat which has not been cooked.

There is also another point to which we have above drawn attention in due course, and that is—that the gas ozone possesses a powerful destructive influence over the bacilli of this dreadful malady. As M. Chauveau has pointed out, we must now fully recognise the grave possibilities of the transmission of tuberculosis from animals to human beings by means of the consumption of the milk and the flesh of tuberculous animals. We read in that valuable Review of Medicine and Surgery, the *Lancet*, of September 1st, 1888, that the Congress at Paris recommended the seizure and destruction of the flesh of every tubercular beast, no matter what its appearance may be. All persons ought to be aware of the risks connected with the meat and the milk of tuberculous cattle, and of the measures which ought to be taken with a view to the disinfection of materials derived from people who suffer from tuberculosis. Dairies and dairy-farms ought to be rigidly inspected at regular intervals. Experiments have proved that animals fed upon tubercular flesh, or inoculated with the virus in any other way, do become victims to the disease.

Thorough cooking would doubtless be a safeguard. Several members of the Congress expressed the opinion that the State should indemnify farmers for the losses which they would sustain if the stamping-out method should be adopted in the case of a disease so commonly met with as is bovine tuberculosis.

Another point is that the question of being infected or not infected frequently seems to depend upon the general state of health.

If, then, it be true, as undoubtedly it seems to be, that this question is determined by the state of health of the animal, we must realise how very important it is to preserve our health properly in as thorough a manner as may

be found possible. Indeed, we ought to be most scrupulously careful about all such matters, especially when we realise how much may depend upon the due preservation of the life and good health of each individual.

For many of the following remarks we are indebted to the excellent work of Dr. G. Sims Woodhead, who delivered two lectures on "Tuberculosis" before the Hon. the Grocers' Company (vide *The Lancet* of July 14th and July 21st 1888) in the University of London on July 9th, 1888.

It seems that tubercles, whether recent or caseous in any part of the body, must be looked upon as centres from which infection of any part may take place. Indeed, tuberculosis may be looked upon as the result of the effects of a specific virus acting upon the tissues which are not able to cope with and destroy it, and very probably it is necessary for the development of the tubercle-bacilli that the conditions should be favourable to the existence of those bacilli, just as in the cases of pyæmia and other allied diseases the conditions must also be favourable for the development of those maladies. For instance, there must probably be some weak point in the epithelial surface wherefrom the bacilli may gain access to the deeper tissues in sufficient numbers to be able to attack successfully in the struggle which ensues betwixt the cells and the bacilli. Those deeper tissues also must be in some measure unable to hold their own, their cells no longer having the power to deal successfully with the numerous bacilli which find their way to them.

The bacilli of tuberculosis are not as a rule present in sufficient numbers in the atmosphere to render them really dangerous to healthy persons breathing the air. Out of 127 cases of tuberculosis in children it was found that in 43 instances there was tubercular ulceration of the intestine, and that in no less than 100 cases the mesenteric glands were found to be in some stage or other of tubercular degeneration. In 14 cases the glands only were affected, *i.e.* there was no tubercle found in any other part of the body. In these cases the glands had become calcified, but in the other instances the glands were markedly tubercular. There were very few bacilli, and in some cases none could be shown to be present, and the nature of the growth could only be detected by inoculation experiments. According to Dr. Goodhart, caseous or tubercular disease of the mesenteric glands is not uncommonly met with; but yet it is rare in comparison with the consumption of the bowels which so often occurs among the poor.

As a rule, infants are suckled during the first year of life at the breast, and afterwards the diet is almost invariably in part composed of milk. Now it is a most significant and noteworthy fact that after the first year there is such a rapid rise in the number of cases in which the mesenteric glands are affected. Furthermore, although tuberculosis is frequently met with in young married women, still tubercular affection of the breasts is very rare, albeit that Dr. O. Hubermaas has recorded no less than eight cases of such affection of the breasts. In cattle, on the other hand, tubercular affection of the udder is by no means rarely met with. It is clearly the case that tuberculosis may arise from the ingestion of milk, especially in the case of young children. Gerlach fed young animals with milk obtained from tuberculous cows, and in many instances he thereby produced tuberculosis of the alimentary tract or of the mesenteric glands. In another case all the pigs which had been fed on the milk of a tuberculous cow succumbed to tuberculosis, and in another instance an outbreak of the disease could be distinctly traced to the milk of three cows in which the udders were markedly affected. Many other observers, including Klebs, Bollinger, Stein, Johne, Bang, Toussaint, Chauveau, Koch, and others, concur in the statement that if the milk of cattle having tubercular udders be

ingested by animals for any length of time, tuberculosis will be developed. Bang has recorded the results of an examination of twenty-seven cases of tubercular mammitis, and he was able to prove the presence of tubercle-bacilli in the milk or in the sediment, and with this milk or sediment he produced tuberculosis both by means of inoculation and by ingestion.

Dr. Woodhead, together with Professor McFadyean, found 37 cows out of 600 affected with mammitis. In six cases they made sure of the existence of enormous numbers of bacilli in the udder by means of microscopical examination. They found new tubercular tissue distributed in patches of various size throughout a portion of the gland, and small round cells provided with large nuclei and epithelioid cells between or amongst which a fairly well developed reticulum was seen. The giant-cells were very numerous, and scattered throughout the new tissue; but they were not so well defined as in the case of human tuberculosis. Caseation may occur at certain points. The new growth of tuberculous tissue gradually invades the lobules of the gland, passing in along the lymphatics of the interlobular septa. Innumerable bacilli are present in the parts which are tuberculous. They are first seen as small stained rings (masses of bacilli) around a slightly granular or homogeneous mass—in fact, the giant cells seem to consist of the débris of cells, the result of the growth and processes of the bacilli. These tubercle-bacilli may also be seen in the smaller cells, and also in the spaces between the cells. At the margin of the new growth, ulceration into the ducts may be made out. The basement membrane of the ducts may give way, and a small mass of tubercular granulation may be seen projecting into the lumen. In the granulation-tissue, the epithelial cells, and in the lumen of the tubes numerous bacilli may be seen lying free, and hence they gain entrance into the milk. Giant cells may perhaps be acini or ducts, in which the bacilli have attacked and destroyed the epithelium.

It seems to be the case that it is only when the functions of the intestine are interfered with, and when there consequently are temporary or permanent alterations in structure and also in the chemical constituents of the fluids and gas in the alimentary canal, that tubercle-bacilli can make their way through the epithelial barrier.

There are numerous cases in which tubercular disease of bone, of synovial membranes, &c., has followed on measles, scarlatina, small-pox, and similar conditions, and when an attack of typhoid fever or other intestinal mischief has been considered as marking the date at which serious tubercular mischief first commenced. In the first instance the glands act as vital filters; but if they degenerate and become encapsuled in fibrous tissue, they may suppurate, and so become centres from which other areas are affected.

Dr. Woodhead, in common with Koch, Bland Sutton, Watson Cheyne, and numerous other workers, holds that any differences which may be discerned between the size, mode of growth, and position of human and bovine tubercle-bacilli are not sufficient to constitute a specific or even a varietal difference. Some bacilli found present in human sputum were at least one-third or even one-half larger than others. Again, he showed a specimen of tuberculous udder in which were tubercle-bacilli, some of which were embedded in epithelial cells, whilst others were lying singly in the spaces between the cells. Klein has shown that fowls may be successfully inoculated with tubercle taken from a human being, that with tubercle from a guinea-pig we can inoculate an ox, but that we cannot readily succeed in inoculating fowls with tubercular matter taken from an ox. Koch states that tubercle-bacilli grow at temperatures varying from 80° to 105° F. Outside these limits it is extremely difficult to obtain a luxuriant growth. In the case of children, especially those who are subject to the

wretched hygienic treatment and bad feeding to which unfortunately so many of our poorer children are exposed, tuberculosis may be contracted as the result of the ingestion of milk from tuberculous udders.

A cow may have a tuberculous udder without the slightest falling off in the general condition. The best way to detect tuberculous disease is to stain specimens of milk, and then search with the highest powers of the microscope for the tubercle-bacilli. The development of the tubercle in the udder is extremely rapid, and hence it would be well to have all cows which supply milk examined every fortnight in order to see if the udders are affected or not.

Dr. Woodhead and Mr. Hare have pointed out "that after one micro-organism has completed its task, another may step in and continue the process of breaking down. How often has a patient suffering from a tubercular abscess of the kidney or of the lungs succumbed at last (if not carried off by acute tubercular disease) to pyæmia, and pyæmia in which the symptoms are exceedingly well defined."

Acute miliary tuberculosis must be looked upon as the result of spreading of the infective material by the medium of the blood-vessels. In a series of several cases of acute miliary tuberculosis Weigert was able to determine that ulceration of the pulmonary vein had taken place. Ponfick previously had supposed that the bacilli might pass from a tubercular thoracic direct into the venous trunks, and thus to the general circulation. Probably both observers were correct. Again, Coats points out that bacilli may pass into the minute venous radicles in those glands wherein tuberculous changes are occurring. Tuberculosis is a comparatively curable disease, and, as we gradually gain more and more knowledge, it is probable that the death-rate may be materially diminished.

It is highly probable that human beings may become infected with tuberculosis by means of the transmission of the bacilli through the medium of the milk or flesh of cattle, or the flesh of swine. It may also be transmitted from a man afflicted with tuberculosis to other persons.

Weigert has shown that a giant cell is, in some cases, nothing more than a collection of cells in which the bacilli are causing proliferation at the margin. In the centre, fusion and degeneration take place, and the result is that a mass of caseous material occurs in the centre, whilst proliferating cells, with bacilli between them, are seen at the margin. Klein has seen the giant cells being formed by means of the fusion of epithelial cells of the air-vesicles. The presence of these giant cells seems to afford evidence that the cells are making a determined resistance against the inroads of the bacilli; that they are slowly giving way, and so limiting the area of caseation. In many cases where the giant cells, with their rings of nuclei, are best marked, very few bacilli are to be found, as they have been destroyed by the phagocytes at the margin, that is, by the active cells with deeply-stained nuclei. In other cases, however, the bacilli have taken the place of the nuclei at the margin of the giant cell, the boundary-line in such cases being determined, for a time, by the basement membrane of the tube in which the mass is formed.

We are indebted for the following note to Mr. Tedbar Hopkin, F.R.C.V.S., Manchester (vide *The Veterinary Journal*, Jan. 1889) :—A friend of this gentleman was called to see a cow suffering from advanced tuberculosis. The cow was killed, and a heifer, the daughter of this cow, being some time afterwards slaughtered, was, by *post-mortem* examination, found to have tubercles pervading the viscera. This event was followed by a serious outbreak of tuberculosis in the fowls on the same homestead, and also in the rabbits on the estate, large numbers dying of the disease. In an adjoining village a rabbit-warren was

stocked with rabbits from the above-mentioned estate for the purpose of supplying rabbits for coursing, and the result was that the disease broke out to such an extent in the new warren that the opinion of the same friend was again sought. This observer also gave an account of tuberculosis in the horse, and it seems that the late Professor Robertson was of opinion that tuberculosis does occasionally occur in the horse ; [but we have never seen a horse so affected.]

"It is quite time," adds Mr. Hopkin, "that more active steps were taken to prevent the milk from tuberculosed cows being consumed by human beings ; and it is one of the things, if properly done, that would materially help to lessen our death-rate in infants."

This gentleman is quite right, and we earnestly hope that some stringent measures will be taken by each father and each mother of a family that their children at least shall not become affected with this dreadful malady by the medium of tainted milk or flesh. Let all milk be of the best procurable kind, let it always be boiled before being used, and let all meat be most thoroughly cooked.

We cannot close our remarks on tuberculosis without once more, in conclusion, drawing attention to the fact that recent work has been of such a high and important nature that we may with good hopes still look onward for yet more perfect knowledge to be gained in the future. It is with much pleasure that we sound this note of confidence and aspiration, for everyone who has ever seen any man, woman, or child, dying from the ravages of that malady must know how much medical men long for the skill and the power to combat the death-dealing inroads of the tubercle-bacilli.

If, then, we keep on striving, so far from not succeeding, we shall surely gain much greater success even than we hope for, and still more perfect knowledge than we seek. It is quite possible, and, indeed, even probable, that we may be even now much nearer a solution of this difficult question than we think for. One point of the utmost importance has been gained, in that we now know that tuberculosis is by no means an actually incurable disease, as was once thought to be the case. In great measure we know the causes on which it depends, both those which are primary and also those which are secondary, and many of these we can and must surely and strongly oppose and effectually resist.

Indeed, we must emphatically refuse to admit, most especially in so far as human beings are concerned, that any disease whatsoever is incurable. Comparatively speaking, even the very worst diseases are curable, and many of them are radically curable. While life remains, hope should be continued always, even almost to the closing scene. In this respect human medicine must always be most favourably contrasted with veterinary medicine, for never should the doctor ever consent to be baffled by any disease or disorder of human beings, no matter how severe it be.

ANTHRAX, OR CHARBON IN CATTLE; BRAXY IN SHEEP.

Anthrax is a disease of extreme interest not only to professional men and agriculturists, but to everyone, from whatever point of view it may be studied. Owing to the recent investigations made regarding the germs of this disease, on behalf of the Government, by Klein and others, together with the discoveries of Pasteur and Koch, we now possess a considerable amount of exact information with which the general public

should have some acquaintance. This is, we may mention, one very important reason why we lay such special stress upon our subject, and it is this—anthrax is a malady of which very little is generally known, and which, if better understood, would, in consequence, in all probability, become much less prevalent than at present, owing to the adoption of methods of prevention. Anthrax, moreover, may be looked upon as a very well-marked type of disease of man and animals, and an acquaintance with the chief types is, in all sciences, an aim to be held in view, and acquired by those who would widen the limits of their observation and knowledge. An acquaintance with its manifestations is as necessary as is the knowledge of its causes, prevention, and methods of treatment, since it is a form of disease often confounded by the unskilled with disorders of an essentially different nature. Among cattle it is better known as "splenic fever" or "splenic apoplexy," which, although bearing relationship with "black-leg" or "quarter-evil," is not identical with it.

The cattle and sheep which roam about seeking food on the hills of Scotland, as well as those which earn their living with far greater ease in the rich and fertile valleys between, are liable to suffer very heavily from different forms of anthrax. It seems that sheep — and especially well-bred sheep—are more prone than are the other domesticated animals to this disease. In certain parts of France, Germany, Lower Hungary, and Scotland anthrax brings about great losses, prevailing for many years consecutively, and possessing highly contagious properties. In England the disease seems to be on the increase, as a consequence, perhaps, of the forcing systems of feeding, perhaps of too much in-and-in breeding, but far more probably it is owing to the gradual dissemination of the germs of anthrax throughout the length and breadth of the country, and to the existence of conditions more favourable to the growth or maintenance of the bacilli of this disease in the environment.

This disease is very often met with in marshy places or undrained tracts of land; but it also occurs on mountainous pastures and on dry grass farms. It is in the summer and autumn that the malady especially shows itself, to the inexpressible horror of the owner of stock, who may perhaps find himself suddenly robbed by anthrax of thirty-six beasts out of a herd of thirty-seven, or of a corresponding number of

members of his flock. It has been recorded by John Gamgee that 150,000 sheep die annually from braxy in Scotland alone. The mortality on the best sheep-walks is something fearful, and over wide districts every flock of sheep is decimated every year.

The term itself, "braxy," is derived from the word "brock," or "brack," which signifies disease. The malady is very destructive on certain high moorlands, and it rages to a great extent amongst sheep which, in the beginning of winter, are fed on turnips, and forced with too much highly nutritious food. In speaking of braxy, we must not omit to point out that this name is often applied to other diseases, such, for example, as chronic diarrhœa, or dysentery, or septicæmia, which are very different from anthrax. In fact, the malady seems to have been at first supposed to be inflammation of the intestines, which indeed are often found in cases of anthrax to be extensively ecchymosed. Moreover, there are certain maladies of sheep which at present have not been satisfactorily explained. As an instance of this we may mention that lambs occasionally go down with a sudden fever, which usually attacks only the best and most thriving of the lambs of the flock. The head is suddenly protruded, the animal staggers in his walk, or may stand still, quite unable to walk, then falls down, struggles a little, and then dies. A dozen may die in twelve hours.

Indeed, this disease is a justly dreaded one, for it attacks and quickly kills all kinds of animals, including birds and even fishes, and no clime is exempt from its disastrous ravages. As a slight exception to the universality of this dread power we may state that pigs, dogs, and cats are very insusceptible to the disease; but the malady has been seen by us in dogs which have partaken of the flesh of animals which have died of the disease. Indeed, Koch has shown that the spores of the germs of anthrax can readily cause infection by finding their way into the alimentary canal. This fact is of importance as showing that the flesh of animals dead of anthrax is unfit for human consumption, and should therefore be prohibited from being sold.

On January 26th, 1887, a cow died suddenly at Chelmsford, and within a few hours several more succumbed. On the 28th thirty members of the herd had died, and soon afterwards nine more fell victims. The veterinary surgeon who attended the

cattle, and also the butchers who cut up some of the carcases, were accidentally inoculated with the disease.

We read in the *Times* of March 23rd, 1887, that the Chief Constable of Cheshire reported the fact of a fresh outbreak of anthrax in the township of Aston, a locality in which the disease appeared afresh recently. Colonel Hamersley adds that during the past week, of thirty-seven animals attacked thirty-six died, and one was killed.

As we have said before, anthrax is very often encountered by the breeders of sheep and cattle in various parts of the United Kingdom and on the Continent. When it affects human beings, anthrax is generally known as woolsorters' disease, the usual mode of infection being the inhalation of the spores adhering to the fleeces of sheep and goats which have had the disease. It also occurs as the so-called malignant pustule, brought about, not by inhalation of spores, but as the result of local inoculation proceeding from the handling of the infected wool, or as the consequence of contact of any abraded part with the carcase of an animal which has died of anthrax.

In past times anthrax frequently raged as a malignant and destructive epidemic in man and in the domesticated animals, and was known at a very early date in history. It is mentioned in the Scriptures as the grievous murrain and blains which afflicted man and beast in the days of the captivity of the children of Israel in Egypt, and we read in Exodus, chap. ix. 3, that the murrain was then upon the horses, asses, camels, oxen, and sheep.

Anthrax also may have been the cause whereby the army of Sennacherib the Assyrian met with total extermination in one single night (2 Chronicles xxxii. 21).* It was described by the writers of ancient Greece under the name it still bears, *anthrax* —a term signifying a burning coal; also by the Latin authors.

* And the Lord sent an angel, which cut off all the mighty men of valour and the leaders and captains in the camp of the king of Assyria.

2. Kings xii. 35 :—" And it came to pass that night, that the angel of the Lord went out, and smote in the camp of the Assyrians an hundred four score and five thousand ; and when they arose early in the morning, behold, they were all dead corpses."

One cannot definitely lay much stress upon this suggestion ; but the idea is not an improbable one, for the army may have encamped on a spot where the germs of anthrax abounded in profusion on the soil.

Horses are occasionally attacked in this country, and the malady is of common occurrence in the equine tribe in Central Hindustan and in South Africa.

In Asia Minor it was known at the time of the siege of Troy. The seventeenth and eighteenth centuries were especially remarkable for the devastations made by many severe outbreaks of this plague. In 1617 the malady was of so fatal a type that over 60,000 people died round Naples from eating the flesh of animals which had died of the disease. At the present date anthrax often rages in Siberia. In Central Asia it is known under the name of *Loodianah disease*, and in Australia as the *Cumberland disease.* As *Texas fever*, in the United States it is of common occurrence, and makes serious ravages among the cattle. According to Toussaint, animals of the value of 20,000,000 francs die annually of splenic fever in France, in which country the disease is termed *charbon.* In Germany it is the *miltz-brand* or *miltz-brand fieber.*

The disease is a contagious fever occasioned by the entrance of the special germs into the blood, and by their presence and multiplication in different parts of the body. It may rage as an epizoötic over extensive areas, or it may break out in isolated spots from time to time. It occurs whenever the conditions are very favourable to the growth of the germs, which are present on the land in certain places. It is less commonly met with in winter than at other seasons of the year, is more prevalent when the weather is tempestuous, when great heat alternates with stormy rains, when the atmosphere is cold and laden with moisture, and, as we said above, in the summer and autumn months. In damp, marshy districts, inundated with water which has become stagnant, and situated near rivers and streams, especially if the weather become hot after being damp, the disease is very frequently met with. As might be expected, when a very hot summer has been preceded by a great downpour of rain, anthrax often breaks out.

During hot seasons it prevails especially on badly-drained lands, and in wet seasons especially on rich and stiff soils. Sudden changes of diet are said frequently to favour the production of anthrax. For instance, sheep which are suddenly allowed to have too much cake and oats may be afflicted with it, *i.e.*, when there has been a sudden change from a very poor diet to a

rich one, or from dry, good food, to that which is watery and not ripe. In fact, animals in poor condition, if placed upon rich keep, are very liable to anthrax, especially, of course, if they do not get sufficient exercise, as may be the case, for example, if sheep are folded on turnips, or if stall-fed cattle are supplied with too much food. Even a more steady advance of condition is not without danger, especially if the animals are confined for space, being folded on turnips, as above-mentioned, or enclosed on a rich pasture, or allowed artificial nutriment in order to be fit for slaughter at an early time. Indeed, strange as it may at first sight seem, anthrax is most frequently met with where the land is best and most nourishing, and it also attacks the most thriving animals.

On some fields in which braxy broke out some time ago, destroying many valuable sheep, the animals had been having too large an allowance of cake and oats. In this outbreak two doses of medicine were administered to each member of the flock, the food was reduced in amount, and no further deaths occurred. It is especially when the food contains a large amount of nitrogenous matter that it is apt to favour the development of anthrax. When the change of food is sudden, as from a very poor to a rich diet, it may be pointed out that the over-highly nitrogenised influx into the blood favours the growth and development of the germs of the disease. The germs of anthrax may be transmitted by means of food or of water, and it seems to be the case that there is much liability of the propagation of the disease if animals be fed on fermenting grains.

Again, shepherds well know that when the moon is at the full the sheep are apt to rove about and stray, refraining from lying down to rest and chew the cud and digest the food that has been eaten during the day. On the contrary, they may at times engorge themselves, and when the morning comes may be found helpless, struck down with braxy. Many deaths among sheep occur when the moon is full. On the other hand, dark, cold, and stormy nights are often attended with a fearful mortality.

We may allude to ill-drained crew-yards, to the contamination of food or water with the germs which have emanated from the carcases of animals dead of anthrax; and also to the fact that flies, without being themselves much injured

thereby, may yet carry the germs about, as factors in the causation of the malady.

An OX, smitten with the disease, suddenly ceases to feed, and to chew the cud, shivers, moves stiffly and unsteadily with rigid limbs over which control is lost, and soon falls to the ground exhausted and unable to move. He may stand awhile with back curved; but, as a rule, the disease soon lays him prostrate on the ground. The pulse, which, in the case of a healthy ox, should number but forty-five, becomes very rapid, feeble, and irregular, the breathing is much hurried and of a sighing character, and the temperature is raised several degrees. The animal may be calmly dejected and look the picture of misery, or may be wildly delirious.

In most cases the spleen is especially invaded, and hence the disease has been termed "splenic fever," but in some cases the bowels are especially affected, the spleen being comparatively free. Severe convulsions are not uncommonly manifested. From the mouth a tenacious fluid (mucus) flows, and the tongue becomes of a darker hue, purplish or dark red. The belly is blown up, the bowels are freely open and discharge liquid and blood-stained excreta, and sometimes a large amount of dark blood. Blood sometimes flows from the nostrils. The white portion of the eyes becomes dark red, the eyes sink into their orbits, and tears flow over the face. If the tissues under the skin of the back and sides be pressed upon, a crackling or crepitation may be felt, a state of things which is known as emphysema. Death may ensue even in the course of a few minutes or a day or longer, and it is only very seldom that recovery can be hoped for. Indeed, as a rule, an animal affected with anthrax soon succumbs owing to the high fever set up by the germs which multiply with incredible rapidity in the blood, and as a result of the general disturbance set up by the enormous quantities of them. An affected ox generally dies suddenly, and frequently in one of those violent fits of convulsions which are common in cases of acute anthrax, or else perhaps calmly in a period of quiet. Sometimes, on the other hand, the animal may be ill for several days, its pulse being rapid and feeble, the breathing hurried and panting, the eyes injected, the mouth hot and clammy, and the bowels irregular. Then these symptoms may subside, the animal may again take its food and chew the

cud, and then after all the fever may come on again and lead to death. In the month of February, 1884, Mr. J. B. Gresswell found two animals dead out of a herd of forty oxen, and another beast which had a temperature of 106·4° F. died on the next day. Twelve other beasts were affected. In one instance after death the spleen weighed eleven pounds and in another fifteen pounds. On the fifth day another beast succumbed, and the remaining ones recovered under the influence of careful treatment and the wonderful effects of sulphite of sodium, a remedy which is of the greatest possible value. It requires, of course, to be used with care, freshly prepared, recently dissolved in a rather large quantity of pure water, in the correct doses, and for a sufficient period. It is necessary to give small doses well regulated.

The spleen is quite disintegrated, and if its capsule be cut into, the contents are seen to resemble a mass of black tarry blood in a fluid condition. Especially in cases when the disease

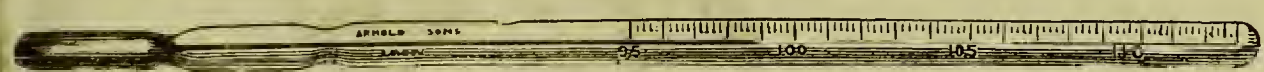


Fig. 26.

A Thermometer by means of which the temperature of a man or an animal may be taken.

takes a slow course is the spleen implicated, and also in these cases the lungs often become much congested, and decomposition of the extravasated blood occurs, the breath becoming very fetid and death resulting. If the animal has passed large quantities of dark blood during life, the intestines will be found intensely congested and covered with extravasated patches after death.

On September the 7th, 1877, the late Mr. D. Gresswell attended a herd of twelve milch cows suckling twelve calves. One was dead on his arrival, its spleen was of very great size, and extravasated patches were seen on the inside lining of the heart. The intestines were inflamed in patches in many places, and abundant extravasations of blood were found on the lining membrane of the paunch, and of the true stomach or abomasum.

The excrement had been blood-stained during the life of the animal. The lungs in this case were intensely engorged, and were of a very dark purple colour. Three more of the beasts died; but the remaining ones recovered. In spite of all the precautions which were taken, on September the 11th the disease

broke out among the horses which had been feeding upon the same grass and drinking the same water as the beasts. One horse died within three hours, and three others which were affected made a slow but perfect recovery. On another occasion —namely, in February 1878, out of a herd of fifty beasts to which Mr. D. Gresswell was summoned only two survived. These animals had been fed upon decomposing grains.

In SHEEP the anthrax germ usually invades the intestinal tract, the splenic form of the disease, in which the spleen is especially attacked, being much less commonly met with than is the case on the Continent, where this kind is the one which generally

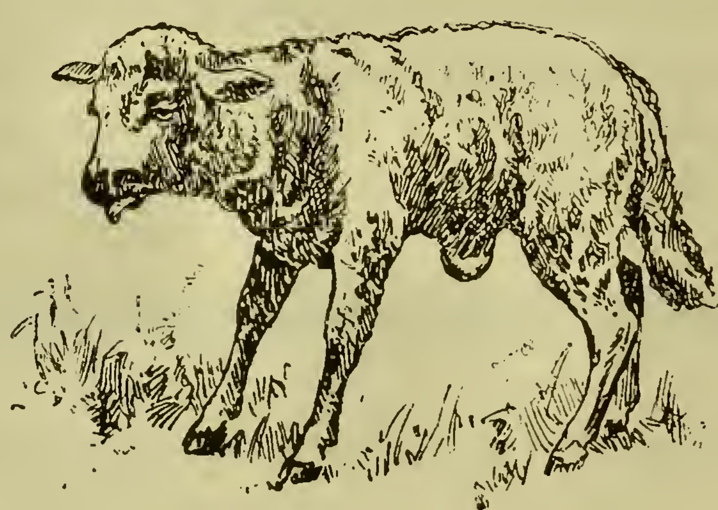


FIG. 27.—NAVEL-ILL.

The above picture represents a lamb afflicted with navel-ill. The navel is seen to be greatly swollen so as to be larger than is natural. The poor little creature's tongue is seen to be protruding, and, indeed, our artist has faithfully delineated a certain look of helplessness and bewilderment which, in the case of a living animal, would incite the observer to search out among the resources of science for some remedy wherewith if possible to remove the cause of the suffering.

occurs. When this is the case, *i.e.* when the intestines especially are affected, the sheep at first walk with contracted step, owing to the abdominal pain. Soon they stand with dejected look, arched back, and then they fall to the ground, and the belly may be noticed to be swollen and tender. After a time the wool drops off. If, on the other hand, the disease especially affects the spleen, the symptoms manifested are very similar to those met with in oxen suffering from the same disease. In lambs, however, this form of the disease is often characterised by external swellings oftentimes involving the navel. In the latter case it is spoken of as " navel-ill."

The symptoms are briefly as follows:—The sheep or other

animal, lively and apparently in perfect health, suddenly falls down while grazing, and may perish in convulsions in the very short space of a few minutes. The affected animal is restless, lies down and rises again frequently, holds the head low, stands apart from the rest of the flock with arched back, picks up a little grass, staggers, stumbles forwards or backwards. The mouth is hot and red, the pulse is full, strong, and frequent, the breathing panting and laboured, and there is a burning heat all over the body. If any feces are voided, they are hard, dry, and scanty, and the urine also is scanty and of a dark colour. The eyes, which at first were bloodshot, afterwards become languid and watery, and the animal drops with a haggard look and stertorous breathing. The sheep may perhaps fall into a ditch, pond, or drain, and be drowned, or may roll over on its back, and, gasping for air with extended head, may soon die. Even before death, swellings may be observed. Gas is set free in the tissues beneath the skin, whereby the latter is elevated along the back and the sides, which, if pressed, give rise to a crackling sensation. Abdominal swelling is often observed, particularly on the left side, owing to the distension of the paunch. Death is, as a rule, very sudden, and generally occurs about a few hours after the first signs of the disease are observed. Decomposition begins very soon after death, and possibly even before the fatal ending.

If death is not so early, the suffering animal may lie down, and be unable to rise again. The breathing is hurried and difficult, the eyes are prominent, the visible mucous membranes are deeply reddened, and discharges of blood issue forth from both mouth and nostrils. After a few hours convulsions may come on, shortly before death. The sheep may, however, continue living, looking uneasy and dull, refusing to eat, carrying the head low and the back arched upwards, frequently lying down and rising again, and refraining from micturition. If the flock moves on, the suffering animal falls behind, and is left in the background by its companions, and it may stagger about slowly. The hair on the face and the wool on the body are dry. If bleeding is resorted to, the blood will be seen to be thick and black, and to flow slowly. The animal looks breathless and excited, the lining membrane of the nostrils and that of the conjunctiva is deep red, while that of the mouth, and especially that

of the lower lip, is studded with light violet patches. The pulse is quick and small, the beats of the heart itself are of a tumultuous nature, the temperature of the body in places uncovered by wool is lower than in health. The sheep may either be constipated or suffer from diarrhœa, and symptoms of abdominal pain may be manifested.

With the view of deciding if a sheep is suffering from anthrax fever, Reynal advises that the animal's nostrils should be closed with the fingers for a few seconds. By this means micturition is brought about, and the urine will then be found to be blood-coloured if the animal is suffering from anthrax. Urine may be easily obtained by means of gentle compression over the region of the bladder.

As the disease progresses, the sheep trembles, cannot stand, gives out a profuse discharge of tears, and also a flow of blood from the nose, loses power of vision, and dropsical swellings may appear on the neck, lower jaw, breast, and flank. Signs of putrefaction may be seen, convulsions appear, and soon afterwards the sheep dies. Death may occur in from one to four hours—it supervenes most quickly in warm weather; but occasionally the course of the disease is more prolonged.

After death, as also during life, the germs and their spores may with the microscope be found in abundance in the blood and tissues. If a *post-mortem* examination is made, the spleen is found to be greatly congested and enormously enlarged, as also is the liver, and the lining membrane of the intestinal canal is congested in some degree. The whole of the animal's skin is puffed out by fetid gas, in consequence of the decomposition going on in the underlying structures. The muscles are of a blackish hue, and petechial spots are noticeable in the serous membranes. The mucous membrane of the intestinal canal is congested, being coated and infiltrated with blood, which, indeed, is also mingled with the contents of the canal. About the nose a frothy mucus tinged with blood is seen. If the skin is separated, there is a very offensive smell, the blood-vessels are full of black blood, and frequently the superficial structures are stained yellowish-red. If the belly is cut, a little straw-coloured or reddish fluid often escapes, the paunch is distended with gas and congested, the third stomach is usually full of solid food, and extravasations of blood are to be observed

beneath the mucous membrane of the digestive tube. The lungs are turgid with blood, and the heart is marked both externally and internally with dark purple spots and filled with dark and partly coagulated blood. As in *black quarter*, extravasations of blood are to be seen, and these are probably caused by sudden congestions, attended by rupture of the vessels and consequent effusion. Sometimes a sheep may live for several days; but as a rule the animal is actually dead within a couple of hours from the time when it was in the enjoyment of good health. This suddenness seems to be due to a general clotting of the blood within the smaller vessels of the tissues.

Now we proceed to give a short description of the germs which cause anthrax fever. We propose to follow the admirable

FIG. 28.—FRESH SPECIMEN OF BLOOD TAKEN FROM THE HEART OF A MOUSE WHICH HAS DIED OF ANTHRAX.

1. Blood discs. 2. White blood-corpuscle. 3. Bacilli anthracis. Magnifying power 700. After *Klein*.

account of them given by our former tutor, Dr. Klein. In the blood of any animal which has died of anthrax numbers of stiff rods differing slightly in length are found. Koch succeeded in cultivating these bacilli artificially, and showed that they multiply by division, and grow so as to become long, homogeneous-looking filaments, which are straight or twisted. If free access of air is allowed, bright oval spores appear in them, and the filaments become homogeneous and swollen. These spores then become free, and, when artificially cultivated and injected into an animal (rodent), they germinate into the characteristic bacilli. These bacilli elongate and divide, and in artificial cultures again grow into long filaments, which again form spores. The single bacilli measure between 0·005 and 0·02 mm. in length, and between 0·001 and 0·0012 mm. in breadth.

Anyone who casts his eye for a moment on the above picture will notice the little rods, quite straight for the most part, which are the much-talked-about bacilli of anthrax, and they will at once see that in regard to the prevention and cure of this dread disease, the questions to be decided depend upon the conditions of growth and development of these minute vegetal organisms.

According to Dr. Klein, any fluid containing proteid material is a suitable medium for the growth of these bacilli; and he also states that they grow abundantly at any temperature between that of 15 deg. C. and 43 deg. C., elongating and dividing rapidly, and growing out into long, curved, and peculiarly-twisted filaments, which often form bundles, composed of filaments twisted round one another like the strands of a cable.

FIG. 29.

The above illustration (after Klein) is one of the bacilli of anthrax artificially cultivated and showing copious formation of spores.

They are magnified so as to appear 700 times larger than they are.

When a thin layer of the bacilli is dried, they die; but the spores remain unaffected. The bacilli of anthrax are truncated,

and they are not capable of movement. It is very important to know that if an animal which has died of anthrax be not opened, its whole body and its excretions being protected from the air by being buried or otherwise carefully disposed of, the bacilli become quite innocuous, and die in about a week or a little more. Hence it is highly necessary that the bodies of animals

Fig. 30.

The above picture represents the microscopical appearance of a small portion of a section cut through the kidney of a rabbit which died from the results of anthrax. The capillaries of the cortex are naturally injected with the bacilli anthracis.

1. A glomerulus. 2. Capillaries surrounding the convoluted uriniferous tubules, which are not here shown. Magnifying power 450 (Spiller's purple). —*Klein.*

which have died of this disease should not be opened, unless it should be supposed necessary. Moreover, too much care cannot be taken by all who have to handle the carcases, since the disease can very easily be communicated to human beings. Hence Pasteur's belief, that earthworms are instrumental in bringing up to the surface of the land the bacilli of anthrax

which they have been contaminated with in their peregrinations under the soil, seems very improbable; and, indeed, Koch has shown that the bacilli of anthrax, when mixed with earth in which worms are placed, are not taken up by these creatures.

These bacilli are always present in enormous numbers in the blood of animals suffering from anthrax. They may be separated and washed with distilled water, alcohol, and ether, and dried; but still, if injected or otherwise introduced into the blood or tissues of animals, they are capable of producing anthrax, and cultivations of the germ may be made through fifty generations with the same result. However, the bacilli of anthrax have been subjected to such treatment by M. Pasteur that if they are inoculated into animals they will produce a mild form of the disease, from which the animal, as a rule, very speedily quite recovers, being at the same time thereby rendered secure against the ordinary virulent disease. Every year thousands of animals are inoculated on the Continent in accordance with the method discovered by M. Pasteur.

This celebrated scientist directs that the germs are to be exposed to a high temperature, viz. one of about 43 deg. C., and also that they are to be passed through different species of animals. The process is, of course, a very elaborate one. It has been invariably found—and, indeed, is a well-known fact—that the bacilli taken from the blood of sheep or cattle which have died of anthrax always cause death when inoculated into sheep or cattle, although, strange to say, after these bacilli have been passed through white mice, they have lost much of their virulence. The blood of white mice which have died of anthrax does not kill sheep, but only produces a transient illness in them, which, however—and here is the point of most extreme importance—protects them against attacks of virulent anthrax.

Further, it is to be remembered with care that the bacilli of anthrax are capable of living and growing on the surface of the soil, and they form spores, provided that they are well supplied with oxygen. If sheep, or cattle, or other animals die of anthrax, and their carcases are not properly disposed of, or if fluids escape from their bodies and get on to the ground, the bacilli thrive on the decaying matter present on the soil, multiply, and even form spores. It is easy to see that such land will continue to be a permanent source of infection to

sheep, cattle, and horses living on it, unless by means of thorough drainage and efficient dressing with lime the bacilli be prevented from further multiplication.

As we have above pointed out, Professor Pasteur has introduced a method of inoculating animals in districts where anthrax is prevalent, with anthrax virus which has been subjected to a high temperature, and passed through different species of animals, whereby it becomes attenuated. According to Dr. Klein, however, this inoculation loses its protective power after a short time. He has proved the intense potency of small quantities of corrosive sublimate on the germs of anthrax, and he advocates the use of a "vaccine," the virulence of which has been destroyed by means of this salt of mercury.

He suggests that a culture in broth of anthrax germs together with spores should be used for the purpose of inoculating a guinea-pig, and then that another guinea-pig should be inoculated with the blood of this guinea-pig, another with that of this latter one, and so on. The guinea-pigs die of anthrax before, or at the end of, the second day after the inoculation. The blood taken from the dead guinea-pigs (of the fourth remove) is then to be medicated and then used for inoculating sheep.

Dr. Klein has shown that so potent is the above-mentioned mercurial salt that one part of it in 25,000 of water will in about fifteen minutes' time prevent the bacilli of anthrax from producing virulent anthrax in sheep, and that sheep inoculated with a mixture thus prepared are thereby protected against subsequent infection with virulent anthrax material. The blood of the dead guinea-pigs is to be mixed with 100 times its volume of a solution of perchloride of mercury of the strength of 1 in 25,000, or 1 grain in about 50 fluid ounces of distilled water. This should be kept thus mixed for about 15 minutes, and then about a half, or even the whole, of the contents of a hypodermic syringe should be injected under the skin of the groin, or inside the thigh of each sheep. After the lapse of a week the injection may be repeated with a mixture prepared in the same way, *i.e.* the fresh blood of a guinea-pig which has died of virulent anthrax is to be kept mixed for 15 minutes with 100 times its volume (as measured) of a solution of perchloride of mercury in the proportion of one part of that salt to 25,000 parts of water.

The beauty of this plan of Klein's lies in its simplicity. The chief requisite is a guinea-pig just dead of virulent anthrax, the farther procedures, viz. the preparation of the proper solution of the salt of mercury, the mixing of this with the blood of the guinea-pig, and the injection of this mixture by means of a hypodermic syringe, not demanding such a very high degree of skill as Pasteur's method does.

If anthrax has existed in a cattle-shed, it must be well swept

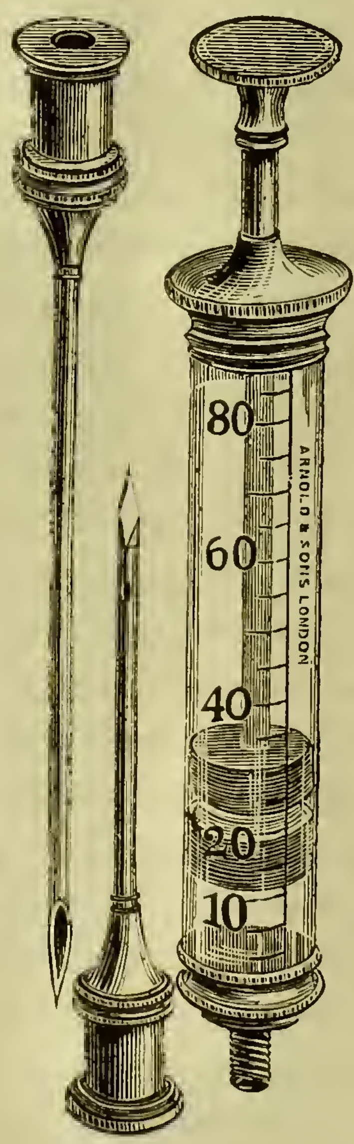


Fig. 31.

This picture represents an injection-syringe used for hypodermic injection.

out, and all litter, dung, or other things, such as implements and so on, which have been in contact with, or used about, the animal or animals, must then be well disinfected or burnt. The walls should be whitewashed with limewash containing a pint of crude carbolic acid to each bucketful, the floors are to be thoroughly washed, and sulphur burnt in the place, so as to fill it with the fumes. The carcases are to be covered over with

a sufficient quantity of quicklime and with at least six feet of earth. All animals which die or are killed should be thus buried without delay, and all fluids or excreta that ooze from the body should likewise be immediately burned, with the same precautions.

Braxy mutton is not sold in Scotland, but braxy hams are to be seen hanging up, and many are smoked in the farm-houses of sheep-rearing districts. Even abroad the shepherds do not altogether reject braxy mutton. It has, however, been shown by Koch that the spores of the germs of anthrax can readily cause infection by the medium of the alimentary canal. This fact is of great importance, as showing that the flesh of animals dead of anthrax is certainly not fit for human consumption, and on no account should it be sold for food, even for animals; and, of course, very much more reason is there why human beings should not eat such meat. Moreover, if the carcases are opened for examination or handled, the greatest care and precaution should be exercised. If there are any cuts or sores upon the hands or elsewhere, on no account should the carcase be even touched. If any one does become affected, a doctor should be at once consulted.

We believe that in past years very much flesh of animals which have died of anthrax has been consumed; but now that a knowledge of the dangers of this practice has become general, it is most earnestly to be hoped that on no account will this most dangerous practice be carried out.

All districts wherein anthrax breaks out from time to time should be thoroughly drained, and the fields should be thoroughly dressed with lime. If an outbreak occurs among a herd of cattle or a flock of sheep, the infected animals and those which are suspected to be infected should be at once set apart. Then either the preventive inoculation above spoken of should be performed on the rest, or to each ox three drachms of sulphite of sodium, and to each sheep about one drachm of the same salt should be given twice or thrice daily for a week dissolved in water. The food supply should be carefully regulated. Moreover, the healthy sheep or oxen should be taken away to a dry pasture, the diseased ones alone being left in the field, from which it is very possible that the germs have arisen. The food and the water should be very carefully looked to. Fermenting

grains, mouldy cereals, and tainted water should be most scrupulously avoided.

Of the infected animals, which must on no account be allowed to come near the healthy ones, the worst should be killed at once, and their carcases buried six feet deep, and with quicklime upon them.

All animals which die or are killed should be buried without delay, and all fluids or excreta that ooze from the body should likewise be buried. Those which are very mildly affected, so that we cannot feel certain that they are suffering from anthrax fever, may be put under medical treatment. The drugs which are indicated are perchloride of mercury (which is a deadly poisonous salt, and can, therefore, only be used with the most unremitting and extreme care), sulphite of sodium, and also salicylate of sodium. Tonics also may be useful. All hard food, straw, and hay must be taken out of the reach of the animals. Easily digestible, soft, nutritious food may be supplied.

In case sheep should go down with braxy in frosty weather, shelter is of very great service.

Farmers should be very careful in regard to taking animals from poor to rich land, especially on lowland farms, on which the sudden deaths from braxy are evidently due to a superabundance of rich grass and of turnips. If braxy breaks out, the food should be checked at once, and on moonlight nights the sheep should be placed on a bare field. Shelter is one of the often-lost-sight-of requisites; but if the flock is kept on the hills, the system of managing them almost precludes the possibility of drugging, or altering the food supply, or of providing effectual shelter.

It is a custom with some shepherds, when they observe that a sheep is suffering from braxy, to cause it to move on briskly, as, for instance, down a hill, and then to pull out a pocket-knife and abstract about a teacupful of blood or a little more from the jugular vein. In no case should more that eight fluid ounces be removed, whether from this vein, or that of the face, or that of the thigh. The vein just in front of and below the sharp prominent process of bone on the side of the face may be opened, after being first filled by pressing on its continuation at the side of the jaw. Then they may give about four ounces of

Epsom salts or of Glauber's salts, or, instead of this, the shepherd often prefers about two wineglassfuls of castor oil. Warm water injections may be of great service in causing the bowels to act.

This kind of treatment has been highly spoken of; but if it is curative, we may be disposed to doubt very much if the animal really suffered from anthrax at all. The abstraction of a little blood at the very outset of an attack might possibly be of advantage in the case of very plethoric animals. If, however, bleeding is resorted to after the very first, it can only do harm, owing to its weakening effect on the animal.

BLACK-LEG, or BLACK-QUARTER.

The disease known under the names of Black-Leg, Black-quarter, Inflammatory Fever, Carbuncular Erysipelas, Emphysema Infectuosum, and Speed, is one of great importance to those owners of stock whose farms are situated in ill-drained, damp, and marshy districts, in which places the disease is most liable to break out. In certain parts in England and other countries the malady is very commonly met with, breaking out time after time, and thwarting the most energetic measures to stamp it out. Black-leg usually begins by affecting two or three or more individual members of a herd or flock, and apparently it spreads from animal to animal through the medium of the air, so that about six of them or perhaps many more may be attacked. It is seldom the case that this serious malady has a favourable termination.

Black-leg is more frequently met with in veterinary practice in oxen than in sheep; but this is no doubt largely due to the fact that farmers as a rule do not seek professional advice for many disorders of sheep. The complaint seems to break out more particularly in the spring and in the autumn, while, as our readers will remember, anthrax most usually occurs in the summer time. However, these two diseases are very similar in many points, and they are very often met with on the same farms.

In the case of oxen, the operation of setoning and dressing the setons with black oil (which must be properly prepared) seems to act as an almost certain preventive. Although in some instances animals suffering from this disease may recover,

as a rule they die in the course of about two or three days from its commencement.

There is an effusion of fluid into the tissues beneath the skin and in those which lie between the muscles of one or more of the legs, or between those of one hind limb and one fore-limb. As a consequence of this swelling, or of these swellings, the animal moves with pain and difficulty. The swellings which are thus formed contain many bacilli, and these small, rod-like vegetal organisms are likewise present in the internal organs. According to Dr. Klein, they are about the size of, but a little thicker than, the bacilli of anthrax fever. Their ends are rounded, and at one of the ends a bright oval spore is often enclosed, which is not the case in regard to the bacilli of

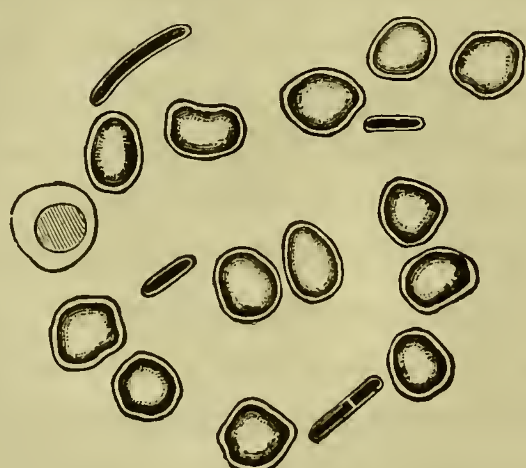


Fig. 32.

Blood of a Guinea-Pig dead of Symptomatic Anthrax (Black-leg).

Blood corpuscles, and between them several bacilli. Magnifying power, 700. (*Klein.*)

anthrax fever. These bacilli of black quarter are either single or form short chains, and some of them move about. If a fluid containing these bacilli be injected under the skin of calves, or sheep, or guinea-pigs, or rabbits, the same disease, black-quarter, is thereby occasioned. If only a very small amount of the fluid containing the bacilli be injected into the veins, only a slight fever is produced, whereas larger quantities cause death.

Animals, however, which have suffered slight disorder owing to injection of small quantities of the virus either into the veins or under the skin, are afterwards protected against what would otherwise prove a fatal dose. In other words, if the malady is produced artificially in a mild form, the animal is thereby ensured against death as a result of this particular disease.

Black leg is a very fatal and infectious disease.

The malady generally attacks calves which are from three to six months old, and although the disease may occur in oxen of any age, it is very seldom met with in cattle which are more than two years old. Moreover, it is generally one-year-old sheep that are liable to be afflicted, and it is very rare that animals above two or three years old go down with the disease. It is, however, believed that this apparent immunity of older animals is due to the fact of their being located in one district, and seldom or never being moved; for in Algeria, where the animals are moved from place to place, this immunity does not exist. It is important that stringent preventive and remedial measures should be taken, for otherwise the disease may spread and pursue its rapid and fatal course.

It is contended by some that black-leg is a disease caused by plethora, that is to say, nutrition beyond the limits of health; and that the best and fattest animals are those most subject to attack. Now, although the disease not uncommonly does manifest itself in the best-nourished animals, it must be pointed out that the high condition of the animal is not be regarded by any means as the primary factor in the causation of the disease. It often happens that scarlet fever and measles and other fevers of mankind invade the more healthy members of a family, while the others perhaps escape altogether, yet who would say for a moment that a healthy condition of the body was a cause of scarlet-fever or other fevers?

It is said that black-leg is especially liable to affect young cattle, taken from a poor to a rich pasture, and especially to low-lying pastures; but we think it is the change from a non-contaminated to a contaminated locality which is the real cause of outbreaks of both black-leg and anthrax.

Black-leg in most instances attacks animals out at grass, but those in the yard do not by any means always escape. It is hardly necessary to speak at great length of the symptoms of this disease, many of our readers unfortunately being already too well acquainted with them. The symptoms are somewhat as follows:—Certain of the best animals of a herd or flock, or of the oxen in the stalls, may perhaps be observed to look dull and listless, and to move with difficulty, and, in fact, to be lame on one or two of the limbs, either hind or fore. The poor creatures rarely move, their limbs are stiff and rigid, and if the

afflicted animals are made to move, they progress without any elasticity of step. The appetite fails, the animals lose flesh, they are very thirsty, and they manifest febrile symptoms. The temperature rises, the pulse is irregular and weak, and perhaps full, and it numbers about 95 or even 120 per minute in the ox. The respirations are very quick, the countenance is much disturbed, the head is protruded, the white parts of the eyes are bloodshot, the mouth is hot, and the animal utters a low moaning. The animal is stiff and rarely moves, and if pushed forward it progresses in a laboured manner, staggers, and drops helplessly to the ground. Rumination is not performed. In the first instance the bowels are constipated, but afterwards the feces become soft and tinged with blood. The skin becomes dry and rough. The urine, at first very high-coloured, afterwards becomes deeply blood-stained. The loins, back, and ribs are tender, and if they are pressed pain is occasioned. Swelling of a painful nature begins, and the swollen part may quickly mortify, either at a fetlock, knee-joint, or hock-joint, or as high up as the stifle, elbow, or shoulder.

It is most generally a hind limb which is thus affected. Sometimes, however, though more rarely, the swelling occurs on a fore-leg, whereas at other times a fore-leg and a hind one may be simultaneously attacked. The swelling spreads quickly, gives rise at first to a considerable amount of pain, and when it is touched, it is found to be hot and tender. The inflammatory action proceeds quickly, and soon gangrene sets in. The swelling becomes insensible to the touch and to cold, and when it is pressed upon, it crepitates, owing to the presence of gases in the tissues. This crackling is very significant. The skin over the swelling sloughs, a discharge flows from the wound thus resulting, and foul ulcers remain.

In protracted cases small ulcers also break out on the mucous membranes, especially those of the tongue and cheeks. The emphysema increases, the extremities and surface of the body become cold, the pulse is small, and stupor comes on. At an early period, generally about twelve hours after the first appearance of the swelling, the suffering animal falls to the ground, and soon becomes comatose, and quickly weaker and still weaker, until, after a day or a little more, death closes the scene. Rarely the tumours burst, and large ulcerated surfaces remain, and in

this case the animal may recover. The flesh is not fit for human food. It is of a deep red hue, gives off an unpleasant odour, and soon putrefies.

It is a most important fact that the spores of the bacilli of this disease, if heated to 85° C. for six hours, lose their virulence. Hence the danger of consuming the flesh would in this case, as in others, be very greatly lessened by thorough and effectual cooking, which, indeed, should always be insisted upon by those who wish to avoid parasites and other evils, liable, or rather almost sure, to be sooner or later the results of eating under-done meat. If the swollen parts are cut into, they are seen to be infiltrated with a blackish red semi-solid effusion.

After death the carcase is seen to be emphysematous all over, the belly is greatly distended, the body is only slightly rigid, and a discharge of blood-stained froth flows out of the mouth and nostrils. When the skin is removed, the cutaneous vessels are seen to be turgid with blood, and over the part affected or over the loins, as well as over the shoulder or thigh, the areolar tissue under the skin is found, as said above, to be infiltrated with dark-coloured blood, and distended with air. If the tissues are cut, they are seen to be matted together by a black exudation, and they are gangrenous. Blood which does not exhibit any disposition to coagulate is in protracted cases found lying between the long muscles of the back. The serous membranes are covered with ecchymoses. The lungs are usually congested. Other parts of the body, such as the liver, kidneys, the mucous membrane of the alimentary canal, and the cerebro-spinal cavity, may be found to be infiltrated with blood. In very rapid cases, or when animals are slaughtered in the early stage of the disease, it is only one of the fore or hind quarters which indicates the existence of the malady.

In certain localities, as we have above pointed out, black-leg breaks out from time to time. Hence, the first step which is necessary is to have the fields or areas in which the malady breaks out thoroughly drained. In short, the hygienic conditions in such places should be thoroughly investigated, and, if any fault is detected, it should be carefully set right. For instance, the water should be searchingly examined. These remarks apply as much to oxen kept in cow-sheds as to those which are out at pasture. When the disease breaks out in a

herd of cattle, the animals which are not attacked should be separated from those which are, and taken away at once to a fresh and dry pasture. If the oxen are not out at grass, their diet should be changed and somewhat restricted in amount. Roots and grasses, as being less easily digestible, should be avoided, and a little good hay, together with a diet which is at once nutritious and laxative in nature, such as one composed of mashes and linseed or oatmeal gruel, should be supplied instead.

To each animal an aperient should, in the first instance, be given, and afterwards two drachms of the sulphite of sodium, together with one drachm of salicylic acid, may be given to each ox, or one drachm of sulphite of sodium and fifteen grains of salicylic acid to each sheep attacked. These two substances may be administered in the food once every day for five days. In the case of oxen the healthy ones should be at once setoned, and the setons should be well dressed twice a day with black oil. If the animals are actually suffering from the disease, the above powder should be given both in the morning and at night. The tumours, if large, should be incised and dressed with a lotion consisting of one part of carbolic acid in every twenty-five parts of water.

SYMPTOMS OF LOCALISED ANTHRAX IN SHEEP.

This disease often affects sheep in various countries, and it seems to single out especially the strongest and best individuals of the flock. When afflicted with anthracoid erysipelas, as this disease is also called, the sheep moves stiffly, or even limps. If the limbs are examined carefully, a tumour of a dark red or bluish tinge may perhaps be observed inside the thigh. This tumour is œdematous, and may crepitate, and as it extends to the abdomen and chest, it soon becomes cold and indolent, the epidermis covering the tumour comes off, and from the denuded surface a reddish fluid exudes. The febrile symptoms also are of a very marked character, the abdomen is distended, and occasionally a blood-tinged foam flows out from the mouth. The suffering animal may die in a few hours, and rarely lives longer than thirty-six hours after the attack.

Glossanthrax is one form in which this disease appears. It may occur in sheep; but it is very much rarer in them than in

cattle. It may, however, be transmitted to sheep, when very prevalent in oxen. The symptoms are very similar to those manifested by bovine animals, and unless successful treatment is carried out, sloughing of the tongue, together with swelling of the head, neck, pharynx, larynx, and other structures lying near may be so extreme as even to induce death by suffocation. Either a few sheep of a flock may be attacked, or the disease may break out in an epizoötic form. The salivary secretion, which is at first colourless, but afterwards blood-stained and offensive to the sense of smell, flows from the mouth. The head and neck begin to swell, the animal breathes with difficulty, and may even be suffocated. Vesicles may be seen on the side of the tongue; these grow, break, and form deep ulcers or abscesses, which in some instances may even break on the external surface of the face.

With regard to preventive and curative measures, the sheep which are attacked must at once be isolated in a pasture to themselves. The vesicles on the tongues may then be freely lanced, and painted with a mixture made of one part of iodine, four parts of carbolic acid, and four parts of glycerine; or, if preferred, with the ordinary tincture of iodine. It is generally best to open any tumours which may appear on the neck or face. At first the ulcers may be bathed with warm water, then with carbolic acid lotion, or they may be dressed with ointment of salicylic acid. The sheep should have linseed mashes, bran mashes mixed with oatmeal, carrots, mangold-wurzel, and, if it is thought to be necessary, good thick gruel may be given by means of a horn.

In all cases the greatest care must be exercised by persons having the management of any animals afflicted with anthrax or anthracoid diseases, lest in curing and tending their patients they may risk their own lives. The greatest danger is that of catching anthrax fever; but in all cases of anthracoid disorders extreme caution is absolutely necessary.

CATTLE-PLAGUE.

The dread plague with which we deal to-day is, happily, not endemic in England. It is, however, of great importance, inasmuch as it might at any time be imported, and in that case the most stringent measures would have to be taken, in order to

stamp it out immediately. The disease is established, and seems to have originated, in the far East. Its Asiatic source has been traced, and Gerlach mentions the Russo-Asiatic Steppes as the regions in which the malady was possibly primarily developed. The question of the distribution of disease in the world in these recent times, when the dependence of specific maladies on the minute vegetable organisms called germs has been proved, is seen to be a point of greater significance than was previously recognised.

Speaking generally of diseases, we may say that they seem to lose gradually something of their virulence. Animals become in greater or less degree used to them, as it were. In relation to cattle-plague, for instance, it has been observed that when the disease comes regularly to a country, it seems to be less fatal in character, while if, on the contrary, some interval of time has elapsed since its last appearance, the attacks are of a very severe type. If imported into a region never before invaded, cattle-plague, in common with other scourges, is of an especially deadly form. We read in the *Veterinarian* for March 1887 that cattle-plague existed at that ime in Bessarabia, Volhynia, Taurida, St. Petersburg, Warsaw, the Don Cossack Territory, and in the neighbourhood of Odessa, and that precautions were being taken at Constantinople to prevent its spread from Odessa.

Cattle-plague is one of those diseases which are essentially amenable to the "stamping-out" policy, and it will be remembered that when the British outbreak occurred in 1865–66, owing to the determined efforts of the authorities, the disease was at length thoroughly expelled from the country. The advice given by the eminent veterinarians of the day, among whom the most able was John Gamgee, was sound and rational. The energetic action taken by the Government, in accordance with this advice, was successful in stamping out the plague, and we feel sure that, should the necessity for prompt measures ever arise again, the invasion would be nipped in the bud even more decisively.

About June, 1865, the plague broke out in England, after the first direct importation from Russia, and writing about February, 1866, John Gamgee, in his classical work on cattle-plague, says at the close of his introduction to that treatise :—
"Great, however, as the present calamity is, there are reasons

to believe that in the end it may tend to do good, by future generations reaping benefit from the costly experiences at the present time." (*The Cattle-Plague.* By John Gamgee, London : Robert Hardwick, 1866. See page 20.)

Cattle-plague is a febrile disease, capable of being readily transmitted from animal to animal, either by direct contact, or even by propagation of the micrococci, by which the disease is in all probability caused, through the medium of the air. It attacks bovine animals and sheep, and may possibly be communicated to pachyderms. So far as we know, it has not been proved to attack mankind, though it is quite possible that it may be capable of doing so.

If an animal recover from one attack, it is very unlikely to suffer again from the same disease. There is no doubt that human beings, as well as animals such as dogs, can carry the virus of cattle-plague and distribute it. In all cases of infectious diseases great care should be taken to submit one's clothes to thorough disinfection, after having attended diseased animals. The doctor and the veterinary surgeon should always take this precaution in regard to any disease which is liable to spread by infection or contagion. It has been said that in Russia one common cause of wide-spread outbreaks of cattle-plague was "the practice of calling priests and people together to pray in cattle-sheds that the plague might be stayed, and the assembled people moving thence from farm to farm." (Gamgee.) It was, moreover, demonstrated by Vicq d'Azyr in the last century, that if the clothes, which had been worn by those who tended diseased cattle, were placed on healthy animals, three out of six would be seized with the malady. These observations would seem to show that human beings are not, at any rate easily, susceptible to the disease, but that they can carry the infection.

The effects of the malady are chiefly upon the lining of the respiratory and digestive passages. The cells which compose the outer layer of the skin, and those of which the internal lining of the respiratory and digestive passages is made up, are filled with more plasmic fluid than usual, and then they rapidly undergo a kind of fatty degeneration.

Recently minute vegetable organisms called "micrococci" have been found in the blood and in the lymphatic glands of

animals suffering from cattle-plague. Semmer and Archangelski have taken "micrococci" from the lymphatic glands of a sheep which had died as a result of having been inoculated with cattle-plague, and succeeded in cultivating them in beef-broth and other suitable fluids. The germs grew very copiously, and with them a calf was inoculated. After seven days it died of cattle-plague.

Now if these micrococci are cultivated so as to give rise to new generations, these germs are less potent for mischief in proportion to the length of time and the number of generations. In other words they, in so far as they become accustomed to live outside living animals, and hence under different conditions, become apparently less and less able to cope with the resisting power possessed by the living cells contained in animals; that is, they cannot so easily grow and multiply inside the fluids and tissues of the higher animals. Further, if sheep are inoculated with the micrococci of such later generations, they are apparently protected against the virulent form of the disease. If the germs are heated to a temperature of about 47 deg. C., they also lose a great deal of their power, and sheep, inoculated with germs attenuated by this means, are not liable to attacks of virulent cattle-plague. Very low temperatures, such as that of about —20 deg. C., also destroy the activity of the micrococci of cattle-plague.

It is on facts of this order that the advisability of the precaution of protective inoculation in certain outbreaks of disease is advocated; but our readers will see that if all this knowledge and these great results have already been gained, still more valuable information will be acquired in the not distant future. There is room in these days for many more specialists on germs, for many workers who, being provided with means, can afford to study under the few first-class workers in England and on the Continent. Unfortunately this is not a field of research which promises ready returns, and even the skilful must be prepared, before they begin, to exercise their abilities, not for money, but for very love of the work for the work's sake.

It is very difficult to recognise cattle-plague unless its presence is suspected. This is in part due to the fact that it varies greatly in the type which it assumes. It is, however, of the

most profound importance that, when seen, cattle-plague should be at once diagnosed; otherwise the disease may gain such headway in the country that even the most severely repressive measures may for a long time prove ineffectual in staying its progress.

For convenience' sake the disease may be studied under the two chief forms, called respectively benignant and malignant, into which it has, perhaps somewhat arbitrarily, been divided.

Benignant Cattle-Plague.—This type of the malady is seen in Eastern Europe, where it is always liable to be met with. In these regions it is, so to speak, indigenous, and having broken out among the ancestors of the cattle living there from time to time, it seems to have lost the great powers which we may suppose it exercised over the cattle subjected to its influence in past times. The oxen have become accustomed to the invasion of these germs into their blood and tissues, and cattle have, by reason of the continued survival of those which are best fitted to resist the attacks of cattle-plague, been developed with the power of resisting the growth and multiplication of these micrococci. Indeed, in dealing with the activities of living organisms, whether animals or plants, one continually meets with analogous cases in which the power of adaptation is most strikingly shown.

Opium-eaters, arsenic-eaters, tobacco-chewers, and great smokers, in common with those who consume large quantities of alcoholic stimulants, exemplify, in the case of mankind, how largely the system can gain the power of resisting the influence of disturbing factors, which in the first instance would have exerted a highly pernicious influence. Those who are addicted to the harmful habit of smoking in excess scarcely realise the potency of the drug which seems to them to be merely a soothing sedative. Yet it is well known that a few drops of the fluid which has collected in the stem or bowl of a foul pipe will, if placed in the mouth of a frog or toad, kill the animal; and the obvious corollary to this observation is that on no account should smoking be indulged in to an inordinate degree. Further, if the smoker will recall the first pipe or cigarette he tried, he will recognise that the power of resisting its unpleasant effects has only gradually been acquired. Thus it is, too, though by no means to the same extent, in the case of diseases, and

this is strikingly shown by the fact that if cattle-plague in its benignant form is propagated from Eastern Europe to other countries where the disease does not exist, it assumes the malignant type.

Now, the symptoms of benignant cattle-plague are not marked, nor is the disease in this form at all fatal in its results. The manifestations of fever are but feeble and transient, and the disease may be shown only by signs of fatigue and weakness in the animals which are attacked. There may be in addition a slight diarrhœa, and also an eruption of the skin, and possibly greater or less disturbance of the function of digestion, together with loss of appetite, shedding of tears, coughing, diminution of milk in milk-giving cows, slight elevation of the body-temperature, and finally, as the natural result of these disturbances of the vital processes, general depression. Yet no one can exaggerate the importance of bearing in mind that even the very mildest of these mild cases of cattle-plague are capable of producing in the cattle of other countries this disease in its most deadly form.

Malignant Cattle-Plague.—Among the cattle of eastern countries, the scourge, though varied and irregular, and, moreover, gradually produced, is of an exceedingly severe character The symptoms to be now briefly described are not to be observed in the same animal, as they vary greatly in intensity and also in regard to order of succession. The nervous phenomena, though the most constant, are also variable ; but having regard to the extreme intricacy of the working of the nervous system, this may be perhaps rather apparent than real. Sensibility may be either heightened or diminished. Sometimes the animals may be afflicted with delirium to such an extent that they present the appearance of suffering from the violent form of rabies. Breathing is performed with difficulty after exertion, or even during rest.

The first noticeable sign of the disease is an elevation of temperature which may be observed by the thermometer or by placing the hand into the rectum. (Guyot.) This rise of body-heat usually appears about two days before the changes in the mucous membranes. In the morning the temperature is lower than in the evening, and it rises during the day, and sinks during the night. It may vary about 1° C., but it is generally about

1·5° C. above the normal. It may quickly rise and reach its highest point in from one to three days, and then sink rather rapidly to its ordinary level, and sometimes even below it. In animals which are about to recover, the temperature is higher during the fourth and fifth days, and diminishes on the sixth or seventh, and even then much more slowly than in those animals which will die. Moreover, if the temperature in the morning is equal to that in the evening, or if it falls rapidly below the normal point, the animal will die.

With regard to the temperature on the surface of the body, it is not equable. The horns, ears, and lower extremities of the limbs may be either very cold or very hot. The muzzle, too, varies in temperature, and it is generally a little moist. The hair is dull and upright, especially along the spine, and the skin is not supple. The animal quickly loses condition. The increase of the general temperature is followed in about thirty hours by a diminution in the quantity of milk secreted. Gradually the amount of milk diminishes, and towards death the secretion of this fluid may be suppressed altogether. The specific gravity of the milk is also diminished, and sometimes the milk has a reddish colour at about the fourth day. Coincidently with the first diminution in the secretion of the milk, the alterations in the mucous membranes, the disturbance of the functions of the nervous system, dry coughing, difficulty in breathing, and loss of appetite are very quickly manifested. Within about three days from the outset, the changes in the lining membranes of the respiratory and alimentary tracts have developed themselves, and in about five days they have reached the most pronounced stage. Death may, however, take place at the end of the first day succeeding the attack, the disease having run a very rapid course.

For those who desire detailed information respecting Cattle-Plague, the work of John Gamgee, above mentioned, is recommended, or Dr. Fleming's Manual of Veterinary Sanitary Science and Police (1875). Those who wish to read up the recent experiments are referred to the foreign scientific journals, such as the *Centralb. f. d. med. Wiss.*, No. 18, 1883, in which they will find Semmer's investigation conducted in co-operation with Archangelski. With regard to treatment, no veterinarian would recommend that any should be tried, if the disease should

again break out in England. On the contrary, the most determined "stamping out" would be imperatively demanded in the interests of the nation; and in burying the carcases of slaughtered oxen the most stringent antiseptic measures would be requisite.

CATTLE-PLAGUE AS IT AFFECTS THE SHEEP AND THE GOAT.

That justly dreaded and well-known scourge known under the name of cattle-plague, the disease which decimated our herds of oxen in Great Britain from 1865 to 1866, is, as we have just said, frequently met with in certain countries in a mild or benignant form. The oxen of those places have, as it seems, in the course of many years, gradually become so accustomed to the disease that it produces very little deleterious effect upon them. Now all kinds of ruminants, not even excluding deer and camels, have been known to suffer from the ravages of cattle-plague. As for sheep and goats, they are very much less likely to contract the disease than oxen, and, moreover, even if they are attacked by it, they are not so severely affected. It has been proved that these animals may be afflicted with the complaint, both as a result of ordinary infection and also by means of inoculation, and that the malady may be communicated from them to oxen or to other sheep or goats. Viseur (quoted by Dr. Fleming) states that at a place called Auchy-lez-Labassée, in France, during the outbreak of cattle-plague in the year 1871, the disease was conveyed from cows to a flock of 400 sheep, which were very much overcrowded, and that in less than eight days' time no fewer than 63 sheep were dead.

The symptoms are briefly as follows:—The animals become weak, lose desire for food, do not chew the cud nor bleat, they droop the ears, and the rate of the pulse and that of the respirations are both accelerated. The lining membrane of the mouth, that of the nose, and that of the eyes become greatly congested, tears in profusion flow down the face, a copious discharge also issues from the nostrils, and a thick saliva flows from the mouth. Red spots appear on the inner surface of the lips and gums, and on the latter a cheese-like substance may be seen. As we said above, the breathing is quick, and we may add that as the disease advances, each respiratory movement is accompanied by a jerking

of the head. Moreover, the animal occasionally gives utterance to a short husky and painful cough, which may be brought on by causing rapid movement. The animal may grind the teeth. The tail appears to be paralysed. Only about half of the sheep which are affected suffer from diarrhœa. They soon look very emaciated, nearly always assume the recumbent posture, and when they rise, do so with great difficulty, and stagger about helplessly to and fro. Their eyes are almost closed, and in some sheep spots may be seen on the perineum and udder and in other parts.

At times they appear to be very near death, but even then they usually recover. The eyes assume a more lively look; on the following day the animal may eat a little and manifest thirst; the pulse and respirations become fairly normal again; there is no coughing; and, finally, the discharge from the nostrils and the formation of crusts disappear within about eleven days from the outbreak of the disease. If, on the contrary, the sheep or goat should die, it will generally be at about the middle of the third day that death will occur, although it may sometimes happen that convalescent animals may perish as a result of exhaustion at about the fourteenth day.

MEASLES IN SHEEP.

So commonly is measles supposed to be a complaint affecting children only that perhaps some persons may scarcely suppress a smile when they read that sheep are liable to suffer from that disease. When thus afflicted, these animals manifest slight signs of fever—sneeze, cough, give forth a discharge from the nostrils, and swell in the region of the head, and especially near the parotid gland. The mouth is hot, the skin dry, and the animal is constipated, and exhibits little or no inclination for food. Towards the close of the second day after the beginning of the illness, an eruption of red and irregular spots appears on the chest, then on the thighs, the sides of the body, and the face. When these spots are pressed upon by the finger, they are felt to be hard in the centre, and after removal of the pressure they are seen to have lost their red colour for a time and to have become white. The secretion of the skin possesses a peculiar odour. The eruption seems to be attended with good consequences, for about twenty-four hours after its appearance both the febrile

symptoms and the swelling of the head subside. In about four-and-a-half days' time the spots become brownish, and at about the tenth day they disappear. The cuticle then generally peels off, and some symptoms of catarrh continue. In cases which have proved fatal it was observed that diarrhœa, coupled with pain, occurred at about the ninth day. It has been proved that the disease can be transmitted by means of inoculation with the matter discharged from the nostrils, or with the scales taken off the skin. Out of 103 animals which were inoculated, only one died. Plenty of water should be allowed, and nitre should also be supplied for the sheep to lick.

ACTINOMYCOSIS: A NEWLY-DISCOVERED INFECTIOUS DISEASE OF ANIMALS AND MAN.

The disease upon which we purpose to discourse to-day is unfortunately of far more common occurrence than is generally known, and is a serious source of loss to the stock-breeder and dairy farmer of our own and other countries. Our knowledge of its intrinsic nature and of its causes and treatment is of very recent date, and actinomycosis is consequently spoken of as "the new infectious disease of animals and man."

At the outset of our description we may briefly state that actinomycosis is a serious malady characterised by the growth of tumours of varying size and shape, generally met with on the tongue, jaw, sockets of the teeth (dental alveoli), bones and soft tissues of the head, and from such spots it may spread and invade neighbouring parts. Some of our readers will no doubt have had the misfortune to have cattle infected in this manner.

Long before the true nature of actinomycosis was discovered, the disease was known; but men had only dim and confused notions of its actual nature. In our own country it was termed cancerous tongue, scrofulous tongue, schirrous tongue, glossitis, and was often spoken of as tubercular in nature, being specified "tubercular stomatitis." In Germany the disease has been a very prevalent one, and has been known as Holz-zunge (wooden tongue), Krebsbacken, Wind-dorn, Schlundbeulen (Throat-boils).

Bollinger was the first to describe actinomycosis in cattle in the year 1887, and to him is to be attributed the honour of first

showing it to be due to a particular fungus termed actinomyces (*aktis*, a ray ; *muces*, a fungus), or the ray fungus. Often have we spoken in these pages of the germs of disease, and not yet can we dismiss them from careful consideration, of such transcendent importance are they. Let us very briefly review the varieties of vegetable germs, or fungi, which cause so much misery to man, animals, both high and low, and to plants both great and small. Their influence is stupendous in all seasons, and in all climes.

Firstly, there are the Schizomycetes, members of which group cause anthrax, tubercle, foot-and-mouth disease, cattle-plague, cholera, swine-fever, scarlet-fever, diphtheria, influenza, measles, small-pox, typhoid-fever, rabies or hydrophobia, locked-jaw, and other diseases. However, the actual causation of some of these diseases has not, as yet, been absolutely demonstrated. This group, of course, includes also vast numbers of members which do not act as causes of disease. Secondly, there are the Yeasts or Blastomycetes, one member of which causes the disease termed Thrush. Thirdly and lastly, there are the Moulds or Hyphomycetes. These, like the second group, have but little power of invading living tissues. Members of the Moulds cause the various varieties of Ringworm, the Muscardine disease of silkworms, the Madura foot of India. Our readers are probably familiar with the common green mould, Penicillium Glaucum, which grows on jam, bread, damp leather, old boots, &c. The fungus itself is found under the microscope to consist of masses of branched filaments springing from a single cell. To the Moulds belongs the fungus Puccinia Graminis, which causes the mildew of wheat. "Smut" which attacks the flower of wheat is caused by the Uredo Segetum, likewise a mould. "Bunt," or the disease which invades the seed itself, is caused by another fungus, the Uredo Fœtida.

Ergot, which attacks rye and other grain, as well as rye-grass and other grasses, is composed of the compact filaments or mycelium, as it is generally termed, of another fungus. When invading pasture grasses, ergot is said to be the cause of some outbreaks of abortion in cows and ewes, and to cause that disease in horses known as "grass staggers," or "enzoötic paraplegia." The fungus which causes the potato disease is the Botrytis Infestus. We might enumerate many others, but we shall

only further mention the mould actinomyces, which causes the disease now under consideration.

The revelations of the microscope have thrown great light upon the nature of diseases, and we are continually gaining new supplies of information from the same source. What would our forefathers have said had it been even suggested to them that locked-jaw was in reality due to a germ? Yet surely this was always probable. We read but a few days ago in one of the dailies that this disease was breaking out among the persons injured in the recent earthquake in the Riviera, and was spreading, especially among those who had sustained severe shocks to their nervous systems. It thus appears, and has often appeared, that locked-jaw disease can spread by infection, by the germ, no doubt, to which the disease is attributable.

To what an extent man, animals, and plants, are the prey of microscopic organisms of vegetal fungoid nature, is only dimly realised as yet by mankind at large. Yet in all the workings of nature one can discriminate most clearly, most distinctly, a great and mighty hand working with a fixed purpose, to one end, with one aim; good, the final goal of ill. Optimism, yes, undisguised, unwavering optimism, must ever guide man in his search for knowledge, in his burning desire to reveal truth.

We will now describe the actinomyces, then speak of the symptoms, and then of the treatment of this disease.

If one of the tumours be cut into, and examined under the microscope, there will be seen a thick group of club-shaped cells —actinomyces—and these will be noticed to radiate from a firm homogeneous centre, and to be joined to it by filamentous stalks. Each of the cells is homogeneous and of a bright slightly greenish lustre. Around the cells is a zone of large cells, each with one to four nuclei. The periphery of the tumour is made up of a fibrous capsule with spindle-shaped cells. The whole together is the nodule or tumour, the "lesion" of the disease in fact.

Owing to the radiating arrangement of the fungus, it was at first believed to be a crystalline substance; but its fungoid nature is established, and it has been relegated to the Ustilagineæ. The fungus in its growth sets up inflammatory processes among the tissues, and even causes their disintegration. The cellular growth around the fungus is to be regarded indeed as of inflam-

matory origin, and it increases as the fungus itself spreads locally, and even in distant parts.

The tumours themselves are generally roundish, smooth on the surface, sometimes hardish, and sometimes soft in consistence. They are generally of a greyish or yellowish white hue, but not uncommonly assume a darker colour. On their surface one often finds a number of small yellow nodules, and these, it may be pointed out, not being found in other growths, are a reliable sign as to the nature of the disease.

Johne found in twenty out of twenty-one healthy pigs he examined that the actinomyces was present in the little crypts of the tonsils. Now, why does not the fungus cause actinomyces here? It is believed that the fungus is pretty widely distributed, but that unless its spores gain access actually into the tissues, through a wounded or abraded surface, it does not set up the disease.

We have said that actinomycosis is especially common in the mouth, and it seems indeed extremely probable that the spores eaten with the food gain such access through slight injuries of the lining membrane of the mouth, caused by the food, such as straw, barley, and chaff. It has been noticed, too, in Lincolnshire, where the disease is very rife indeed, that the malady is especially common in animals fed on straw, barley, and chaff. But no doubt many other kinds of food oftentimes wound the mouth. Why do they, therefore, not cause actinomycosis? Our readers are aware that straw is often very mouldy, and infected with vegetable parasites of countless kinds; and thus the same straw which causes the abrasion, implants the spores of the fungus which sets up the disease.

It has been demonstrated that the disease can spread from one animal to another; indeed Johne showed this by actual experimental demonstration. When an ox is so afflicted in his tongue, no doubt he conveys the disease to others feeding in the same crew-yard on the fodder provided for all. There is related the case of a woman who was attacked with actinomycosis. She had been often among sick cattle, and had no doubt become thus infected. Yet it is probable that the transmission of the disease from one animal to another, or to man, is rather uncommon. No doubt the animals derive, as a rule, their infection from one common source.

The fungus found in the tumours of cattle forms globular tufts, from ·11 millimetres in diameter. The majority of the tufts are aggregated in mulberry-shaped masses of from ·5 to 1 millimetre in diameter, and appear to the unaided eye as very minute dull-white granules. Of the appearance of the fungus under the microscope, it is our intention to give a representation below. The tufts themselves are not uncommonly calcareous.

There are several reasons why we lay great stress on the importance of acquiring a clear knowledge of actinomycosis.

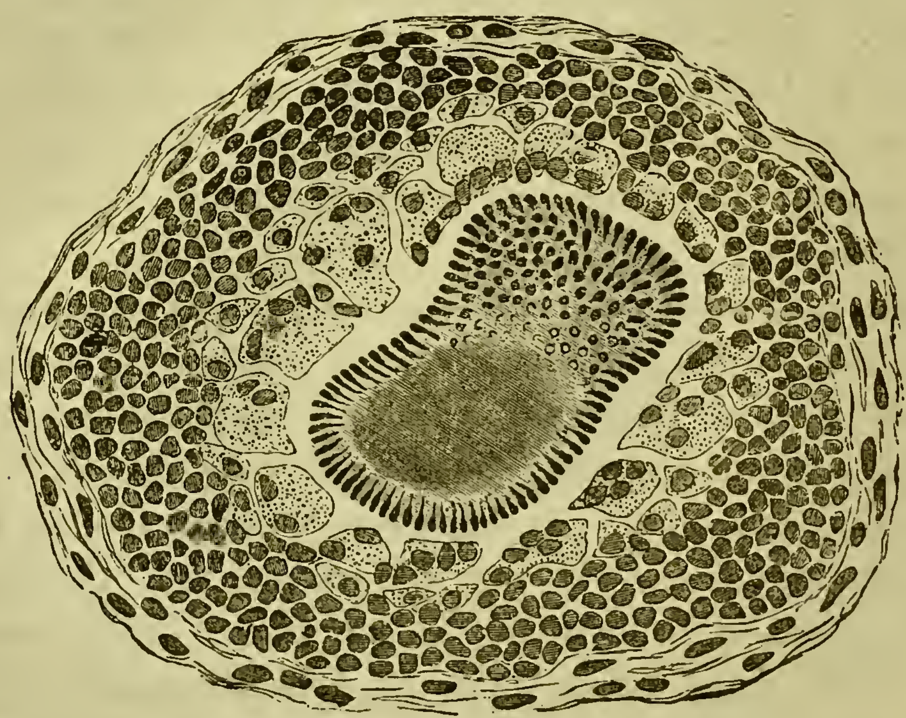


FIG. 33.

The above picture represents the appearance of a section cut through a small part of the tongue of a cow which died of Actinomycosis.

A nodule is shown composed of round cells. In the centre is situated the clump of actinomyces, surrounded by large transparent cells. Magnifying power, 350. *(Klein.)*

In the first place, it is much commoner than is generally known, and it seems to be on the increase. Secondly, very few agriculturists have become acquainted with its nature as yet, and, as a rule, they do not isolate infected animals. Lastly, and chiefly, it has been stated, and, indeed, has been emphatically held, that actinomycosis is an incurable disease. So far from this being the case, we can definitely affirm that almost every case is curable when treated in the early stages, and very many are curable even in the late stages, when the fungus has not spread very widely. During the present year (1887) we have had seven cases under treatment, and six of them have made a good

recovery. In sheep we ourselves have not met with any cases. Doubtless, sheep may become affected; but, fortunately, it is not common among them. The goat is sometimes affected.

Of the symptoms and methods of treatment of actinomycosis we now propose to treat; but before concluding we ought to point out emphatically the inadvisability of employing mouldy food for horses or cattle, for it is so commonly a source of disease. Mouldy oats, mouldy hay and straw are equally bad for cattle or horses, and should not be given as food.

Of the many natural groups of the vegetable kingdom probably no one is less generally studied by agriculturists than that of the fungi, to which the moulds or hyphomycetes, of which we spoke above, belong. There is another mould which we might have mentioned, it being of great interest as the cause of salmon disease. We allude to the *saprolegnia*, a fungus which consists of colourless tubular filaments forming gelatinous masses on living or dead animal and vegetable matter existing in fresh water.

Our readers are aware that no fungus contains any chlorophyll, the green colouring matter which gives other vegetals the power of dissociating the carbonic acid gas of the air, so as to retain the carbon and liberate the oxygen. This, green plants are enabled to do in the presence of sunlight; but fungi cannot live without organic matter, living or dead, unless certain complex organic compounds, such as tartrate of ammonium, be supplied. The saprolegnia grows on the skin of living fish, and thus sets up serious mischief, just as *Tinea tonsurans* grows on the hair of man, or *Tinea circinata* on the human skin.

It is to Professor Huxley that the honour of first demonstrating this fungus as the cause of salmon disease is due.

The filaments of this mould penetrate the scales of the skin in the affected areas of the salmon, and then they grow inward, boring their way through the superficial layers of the skin. The stem portion of the parasite is situated in the scarf-skin or epidermis, and the root portion in the deeper layers; each of the filaments then elongates and branches out. The free ends of the stem filaments rise above the surface of the skin, and become converted into flask-shaped *zoosporangia*, or little bulbar endings containing in their interior numbers of oval spores or *zoospores* possessed of motile power. This power they

have in virtue of the possession of a little flagellum or elongated whip-shaped filament at each end. The zoospores or spores finally escape from their enclosing sac or *sporangium*, and, attaching themselves to the skin of the creature they infest, they repeat the process of penetration.

In the accompanying figure the sporangium A is seen filled

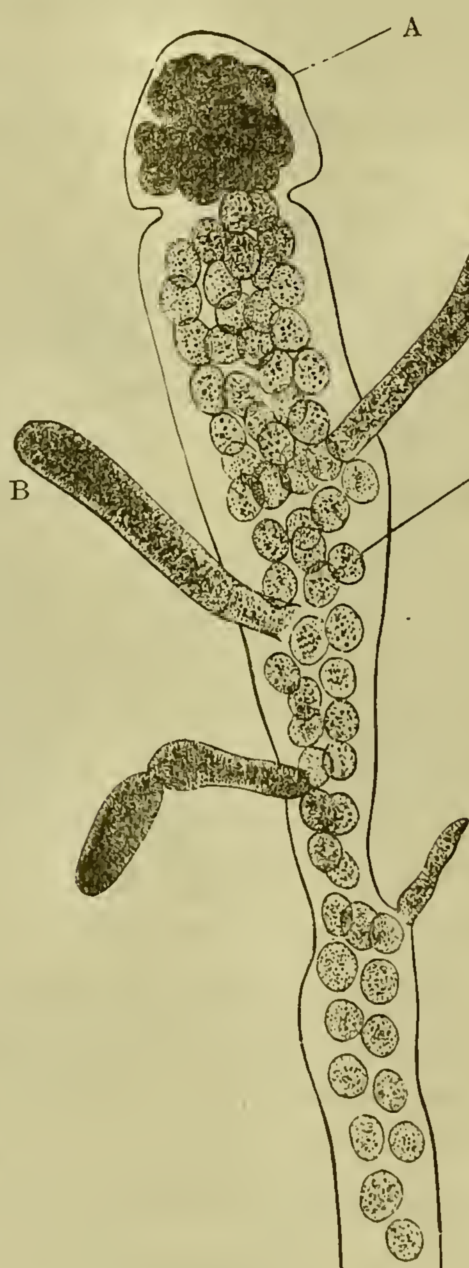


FIG. 34.—SAPROLEGNIA OF SALMON DISEASE.

A Sporangium filled with zoospores, and in connection with them several young mycelial threads.

with oval zoospores, C; several young filaments, B, are seen in connection with some of the spores. Besides this method of development, the parasite also reproduces itself in another way, such for example as we may see in the *Achlya*, which forms a mould around dead or weak flies and " blue-bottles," ivyberries, &c. At the end of a filament a cell forms a large round sphere,

the *oogonium.* There also grow from the cell thin filaments termed *antheridia,* which pass towards the oogonium with the material of which they merge. The oogonium then develops into a number of spores which escape and form moulds again.

The actinomyces which we have already described, when magnified seven hundred diameters, is seen from the accompanying figure to be arranged in a radiate manner around a central homogeneous mass and is relegated to the Ustilagineæ.

We propose, after these preliminary remarks, to consider the symptoms caused by the growth of the fungus actinomyces. The usual seat of the tumours caused by the actinomyces is some part of the mouth, in most instances the tongue being

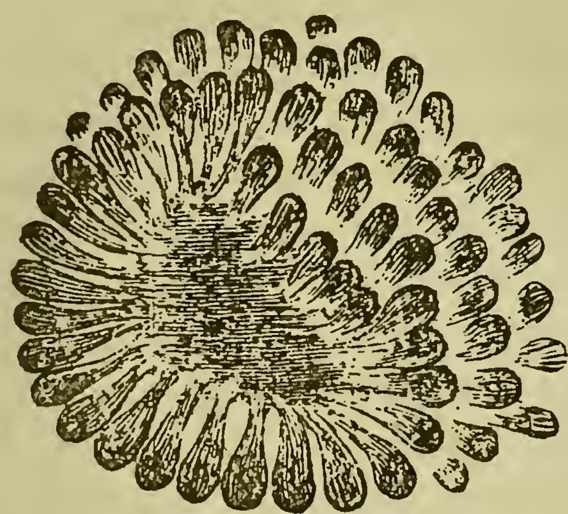


FIG. 35.—TUFT OF ACTINOMYCES, HIGHLY MAGNIFIED.

the organ only or specially invaded. When in the tongue, the growths are noticed to vary in size from that of a tiny spot to that of a small orange. As a rule they grow rapidly, and may speedily invade the greater part of the tongue, and even the neighbouring parts. When the tongue is examined, one finds the elevated portions or prominences in greater or less abundance on the upper surface or on one or both sides of the organ. Sometimes they are found covering the entire surface. In appearance they look like excrescences flattened on the surface, or, if they have been in existence some time, they may appear as irregular ulcers, the inflammatory product caused by the growth of the fungus having broken up. Such excrescences or ulcers may be found singly or in little groups. The tongue itself is enlarged and hardened, and may be ulcerated in one or many

parts; the actual muscle of the organ becomes atrophied by the growth of the fungus, which not uncommonly spreads to the jaws, palate, gums, and cheeks, and even sometimes to the gullet and stomach.

Enke thus describes the tongue taken from a cow freshly slaughtered after having had actinomycosis six months. The back portion was much swollen and elevated. About three inches behind the tip were found a number of irregular sharply defined warty excrescences over the entire upper surface of the organ. In size they varied from that of a linseed to a hen's egg; the largest having broken through the lining membrane, while the smaller ones could be felt as little irregular lumps beneath it. The large ones were like oval flattened warty growths, without any epithelial coating; their colour was yellowish, and they were soft and elastic to the touch. The largest of these was on the right side of the tongue, and it measured 4½ centimetres long and 3 centimetres broad, and 2½ centimetres high. On the surface of the tongue there were also found three large well-defined reddish cicatrices with small irregularities on their surfaces. When the tongue was cut into, the tissues were found to be very resistant, and the cut surface showed an enormous number of greyish and yellowish white nodules imbedded in patches in the pale-red muscular tissue of the organ. The upper surface of the incised bodies showed a number of millet-seed yellow nodules. The weight of the tongue was 5 lb. 7 oz.

In some cases the tumours have been found growing at the sides of the back of the mouth, where they cause difficulty of swallowing. When they occur at the opening of the gullet, they may occlude its channel, and thus the food may pass into the windpipe and disease of the lungs be set up. Sometimes the upper portion of the windpipe itself is invaded, and even the nasal cavities are not uncommonly thus affected. In some cases the bottom lip is greatly indurated and enlarged, this being the only manifestation of the disease.

We may now consider the actual symptoms manifested by an infected animal. The first case to which we call attention as illustrating these was one of a two-and-a-half year old bullock, the property of a cattle-dealer who had kept and fed him on the Wolds of Lincolnshire. It was first noticed that the beast,

which had fed badly for some time previously, was slavering profusely. He would eagerly champ and chew his hay and seeds, and would then throw them out of his mouth again. When the animal had been ailing for about three weeks, Mr. J. B. Gresswell was called in. The tongue at the time was so bad that the animal could eat no solid food. At the same time there was a heifer in a similar condition, and two other bullocks were also slightly affected. All had several hardened yellow nodulated masses in their tongues. In the first-mentioned animal the tongue was very much enlarged and was very tender to the touch, and the sides and back of it were studded with nodules varying in size from a marble to a pigeon's egg. One at the back of the mouth in particular was very large with a superficial erosion. The animal lived solely on mashes and linseed gruel, and at this time weighed about forty stones or under that amount in the opinion of the owner. The heifer was killed; but it was decided to adopt curative measures in the case of the bullock. In this animal the breath was already very fetid, and, indeed, the breath generally becomes offensive as the disease becomes established.

On March 12th the animal was cast, and the tongue was carefully examined. Into each nodule an incision was made, and the cut surfaces were painted over. On the 16th of March the beast was seen again, and it was found that all the incisions were nearly healed. In many places the nodules were smaller, and some had quite disappeared. On March 21st we saw the bullock for the last time. He was very much better, and could eat hay and straw. In April he was turned out to grass. On September 14th the dealer reported the animal as quite well, and calculated his weight at not less than seventy stones.

Slavering and champing of the jaws in beasts affected with actinomycosis is as common, when the disease becomes confirmed, as it is in the case of foot-and-mouth disease, of which, therefore, it cannot any longer be regarded as an infallible sign. The loss of flesh from the inability to eat in cases of actinomycosis is very common, and the emaciation is often very extreme. In the early stages, however, the animal's appetite may remain unimpaired; but with the progress of the disease it almost invariably suffers.

There are instances where it would manifestly not be advisable to treat cases of actinomycosis, when the disease has made

great progress, and has already invaded extensive areas of the tongue and mouth; but in most instances treatment should be adopted, unless the animal be already fattened for the butcher.

Where there are but one, two, or three, tumours, not of large size in the tongue, it is our custom, after having had the animal secured, to incise the growths with an ordinary scalpel, and paint the cut surface with a mixture of carbolic acid and iodine (iodised phenol). This operation, in the general way, does not require to be repeated; but the tongue may be washed over on alternate days in the succeeding week with a diluted solution of carbolic acid and iodine in water. When the growths are already ulcerated, they should be similarly treated. After the operation, the animal should be kept up, being fed on mashes and other soft food. When the incisions are healed, he may be turned out to graze, unless there should be any fresh manifestations of mischief.

In very severe cases it will be essential to have the animal cast before operating; but in milder ones this is not found necessary, the beast being secured by the nose-pincers of the kind here delineated.

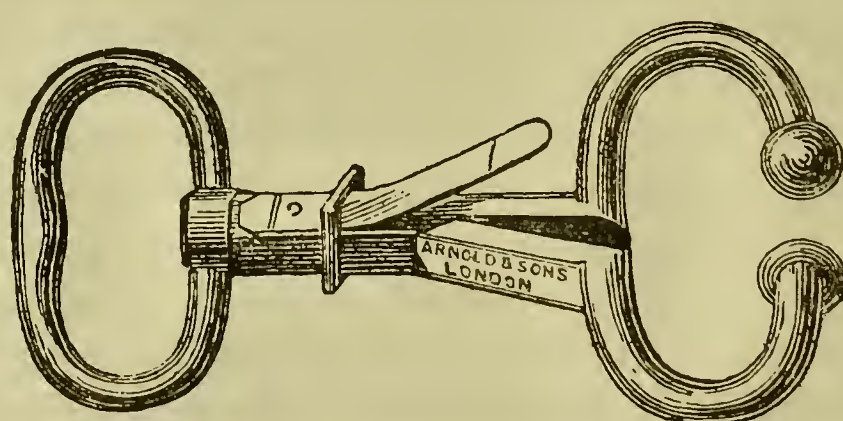


FIG. 36.—NOSE-PINCERS.

As a rule, it will not be found that the diagnosis of actinomycosis presents any great difficulty, and the above operation is not generally one likely to set up any constitutional mischief. In almost all instances we have found it successful when performed at an early date. When first introduced to the notice of the profession (vide *Veterinary Journal*), the disease was held to be incurable. It is, therefore, fortunate to be able, after a considerable number of cases treated, to report very favourable issues in almost every instance. In those cases where the

tongue presents large ulcerated surfaces, incision is not practised, but lotions of iodine and carbolic acid are used daily.

An animal infected with actinomycosis should not be allowed to feed from the same fodder as the others, and isolation in a neighbouring crew yard may be advisable. If the animal is out at grass, we do not consider isolation necessary; but it is certain that one animal may spread infection among a great number of oxen if they are aggregated together in a crew yard.

RABIES, OR HYDROPHOBIA.

We now come to a consideration of a disease which has recently excited more interest than any other in the whole range of pathology. Those of us who have witnessed human diseases in their worst forms cannot but recognise how important it is that the investigation of them should be continued with a never-faltering enthusiasm, and men will be the more ready to exert their very best efforts, the more deeply they realise how much remains to be discovered by those who search after the great truths of nature.

To those who wish to make a special study of this disease we recommend Dr. Fleming's work on *Rabies and Hydrophobia*, and the several other writings on this subject.

With regard to the two names, *Rabies* and *Hydrophobia*, it seems to us preferable to use the former in order to designate this deadly disease, at any rate as occurring in animals, albeit that the malady as affecting man is more generally known under the latter denomination. This latter appellation seems to imply that an actual fear or dread of water is almost universally a conspicuous symptom of the malady. Now, it is quite true that human beings afflicted with the disease do rather frequently exhibit a repugnance to fluids. However, this aversion to liquids seems to have been only seldom observed in the case of animals suffering from rabies, and probably it is by no means invariably shown even by human beings so affected. It has even been said to be rather rarely met with. On the other hand, it appears to be indisputable that the symptom of greatest diagnostic value in the case of mankind is the respiratory spasm excited by attempts to swallow, and increasing until it resembles a convulsive action, such as might indeed be prompted by intense fear of being obliged to try to swallow. The muscular

difficulty may be either cause or consequence of dread, or the two phenomena may be so inseparably connected as not to be capable of being satisfactorily unravelled. In any case, the fear of liquids seems to be due to the difficulty of swallowing, and there may be spasms of the pharynx, œsophagus, and other organs near. A similar fear of water is said to be manifested in patients suffering from other diseases such as phrenitis, hysteria, and gastritis. Moreover, rabid animals seem to be possessed with an intense fear of every object, whether living or inanimate. On the whole, everything being considered, it may appear to be the case that by the use of the word *hydrophobia* we might be giving undue prominence to one symptom which seems to be a minor and rather unimportant one, at any rate so far as animals are concerned. In short, in reference to animals the name *rabies* appears to be the more correct one of the two. Probably many will prefer the word *hydrophobia* for the same disease when attacking human beings.

At the outset we may say that the disturbances of the nervous system which sometimes mark the beginning of cattle-plague are to be compared with the symptoms of rabies in the ox. The fits of delirium which occasionally appear in cattle-plague, as well as the great depression, apathy, and unsteady gait, have some resemblance to similar manifestations shown at a certain stage of rabies. This similarity is, however, only very superficial, and the temperature is much elevated in the case of animals suffering from cattle-plague.

Some little time ago, in the year 1887, a poor fellow died in Nottingham of hydrophobia, which, as our readers are fully aware, is identically the same as rabies, and can apparently only be produced as a consequence of the bite of rabid animals. (However, an exception to this last statement has been recorded quite recently. A short time ago a man died of hydrophobia, and upon inquiry no history of a bite could be elicited.) A dog had run into the man's house after a cat. The man, after succeeding in separating the animals, had received a bite from the dog while taking it out from the place in which it had secreted itself. After some time (our readers will recollect that a man cannot be considered safe from the disease until twelve months at least have elapsed) the man was attacked with this terrible affliction, and died in great agony, shrieking out "Oh, why was I

afflicted with this dreadful disease, I with a wife and family to support?"

We may also give the following short account of a death from this dread disease, which occurred on November 4th, 1887, at Bradford.

"An adjourned inquest was held on Tuesday—before Mr. J. G. Hutchinson, borough coroner—in reference to the death of John Davey (40), farmer, Schoolbrook, Tong, who died on the 4th inst., at the Bradford Infirmary, from hydrophobia.—Dr. Vaughan, the house physician at the Bradford Infirmary, said that the deceased was admitted to the Infirmary on the 2nd of November, and appeared to be mentally depressed, and was quiet. Witness inquired about the history of the case, and the deceased told him that he had complained about a slight pain over the left eyebrow, but this had become very much worse, and had spread over the whole of the side of the head and down the neck. He complained also of stiffness in the neck and a deep-seated pain behind the left ear, and said that on Monday night whilst going home from the station he could not face the wind, and that when he reached home he could take solid food, but any attempt to drink produced such painful spasms that his wife had to purchase a rubber tube, so that he might be enabled to take liquid. Having described the mode of treatment followed and the progress of the case, witness said that the cause of death was certainly hydrophobia. In his (the doctor's) opinion when the symptoms had set in to the extent they had in this case, and definitely declared themselves, there was no cure. In the treatment of the deceased, witness had the assistance of Dr. Goyder and other medical gentlemen.—In answer to the Coroner, Witness said that he had seen scores of cases where persons had been bitten by mad dogs, and not one had proved fatal where there had been an effective treatment of the wound in the first instance. If the poison, however, was once absorbed, he thought that the result must prove fatal.—The jury returned a verdict of 'Death from hydrophobia.'"

The above account is taken, so far as we recollect, from the *Yorkshire Weekly Post*. In regard to the question whether immediate treatment can or cannot put a stop to the effects of the virus of rabies it is very difficult to speak positively. We rather incline to the idea that Dr. Vaughan may be right; but

there is always room for the greatest apprehension after a person has been bitten by a mad dog, even if the most approved remedies have been applied locally at once and in the most effectual manner. Probably permanganate of potassium might be very valuable if applied at once either as a fine powder or in the form of a strong solution. This salt seems to be very highly efficacious in regard to snake-poison.

It would be most interesting, as well as valuable, to discuss here the rise and progress of various inoculatory methods, vaccination, inoculation for pleuro-pneumonia, for anthrax, for cattle-plague, and so on; but time and space forbid. We have little hesitation in saying, having regard to the work of the most noted investigators, that inoculatory methods are now to be regarded as among the most powerful remedial agents we possess, and that so far from not receiving endorsement, they will be proved more and more serviceable in eradicating outbreaks of disease whether among men or animals, as our knowledge gradually advances towards greater perfection.

Speaking generally, it may be said that protective inoculation is one of the greatest of modern discoveries, and that there can be no doubt that continued research will help us very greatly in regard to our methods of dealing with such dreadful diseases as that now under discussion. A Select Committee of the House of Lords on Rabies in Dogs, reported that while it cannot be absolutely demonstrated that the disease does not arise spontaneously, it is nevertheless practically known that subcutaneous inoculation with the virus of rabies is the only ascertained means by which the disease can be produced.

The following are the recommendations of the Committee:—(1) That when rabies is prevalent the muzzle should be enforced; (2) that the power of the police constable should be extended to authorise the slaughter of stray dogs; (3) that the symptoms of rabies should be endorsed on dog licences; (4) that local authorities should have power to order that dogs should wear badges which may identify their owners; (5) that in populous places local authorities should place restrictions upon dogs generally, and especially deal stringently with apparently ownerless dogs in their districts; (6) that in the event of its being conclusively proved that M. Pasteur's system

provides a preventive remedy, facilities should be afforded for its application in England.

Now with regard to this, we wish to point out, firstly, that the most severe repressive measures are not only absolutely essential, but also that the Government, in issuing the Rabies' Orders, and in enforcing them, have deserved well of the country. Secondly, we have to reiterate to our readers that if there is the least suspicion of rabies existing in a dog that has bit a man, that man, if he can possibly do so, ought to submit himself to the protective measures of M. Pasteur, unless he is prepared to run the very gravest risk of dying of rabies, and moreover, of dying in great suffering. M. Pasteur has done a great work in this subject. His researches on the silk-worm disease, on anthrax, and on rabies have been wonderfully successful, so much so that we can hope for success even greater still.

In dealing with rabies, as we have seen, there are two great things to be done. The disease must be "stamped out," and it must be met, when its presence is suspected in men, by protective inoculation. Every dog which is even supposed to be affected should be slaughtered at once and without hesitation. There are some good people about who would say, perhaps, "Let the poor dog live"; but if they had the least conception of the immense issues at stake, even the most humane humanitarians would not be prepared to risk the untold misery that may result from one night's freedom of a rabid dog not muzzled.

It seems to be popularly believed that "rabies" is primarily developed, so to speak, in the dog. The point is not cleared up in any way, and, indeed, it is one which presents great difficulties. Probably rabies may originate in the cat, fox, jackal, hyena, wolf, and perhaps other animals. However this may be, and in passing we may observe that the whole question of the origin of diseases requires elucidation, which it may probably soon receive, it is probable that when once its virus is developed, rabies is capable of being transmitted to all warm-blooded animals, and the human race is very liable to suffer from its dreadful ravages. It cannot be said that any method of treatment has as yet been proved to be thoroughly effectual. Even the preventive inoculation of M. Pasteur does not appear to have been uniformly successful in arresting the progress of the disease. Some time ago Dr. Gresswell, while house physician to Dr. Southey at St.

Bartholomew's Hospital, recorded a case of a patient afflicted with this malady. Pilocarpine was used; but, as has since been observed in other cases, this drug was powerless to avert death. No one who has witnessed such a sad spectacle as a death from hydrophobia is likely ever to forget it.

The helplessness of the physicians to control the effects of the deadly virus affords matter for painful reflection, and those who feel this most acutely will be the most ready to acknowledge the value of the efforts M. Pasteur has made, and to believe that by renewed attempts alone shall we be able to open completely the door, probably now very nearly opened, with the key which this able observer has perhaps all but succeeded in finishing. We hail with feelings of satisfaction the continued efforts to complete the work of this most able observer. A man may be bitten by an apparently healthy dog, and the injury inflicted may be so trifling in its appearance as to be unheeded, or treated in some simple way. A period of perhaps several months may elapse, and the accident be almost forgotten, and then distressing symptoms may show themselves suddenly. After a brief space the doomed victim expires in agonies terrible to witness, and incapable of being more than slightly alleviated. Herein is a problem presented which, since the days of the Asclepiadæ, has perplexed scientists of all nations and every age. In these days we are almost as it were in view of the goal, but yet the clue seems not quite complete, and even perhaps still not absolutely certain.

The malady is nearly always propagated by the bite of a rabid creature; and it is a most unfortunate characteristic of the malady that even the most harmless animals, when suffering from the disorder, seem to be impelled to bite any other animals which may be near them, and in this way the infecting virus contained in the saliva finds its way into the blood of any unfortunate individual, whether man or animal, which may be the object of attack.

History.—We have evidence of the existence of rabies in the earliest times. Plutarch mentions that the disease was first observed in the days of the Asclepiadæ, the descendants of Æsculapius, the god of medicine. These men, who were priests, prophets, and physicians, spread through Greece and Asia Minor, and seem to have handed down the medical knowledge

they acquired in the temples as secrets transmitted from father to son. Aristotle, in the fourth century before our era, asserted that human beings were exempt from attack. Celsus, three centuries after Aristotle, maintained that the bites of all animals were dangerous, owing to the presence of a virus. He recommended caustics, burning, cupping, and also that the wounds of those who have been bitten by rabid dogs should be sucked. He recognised, too, that it is most essential to the safety of the person who does this that there should be no sores or abrasions on the lips or in the mouth. He goes on to say that:—" The only remedy is to throw the patient unexpectedly into a pond, and if he has not a knowledge of swimming to allow him to sink, in order that he may drink, and to raise and again depress him, so that, though unwillingly, he may be satiated with water; for thus at the same time both the thirst and the dread of water is removed."

This formidable treatment has been continued up to a recent period, and Van Helmont gives a curious illustration of its application and success in his day:—" I saw a ship passing by it, and therein an old man, naked, bound with cords, having a weight on his feet; under his armpits he was encompassed with a girdle, wherewith he was bound to the sail-yard. I asked what they meant by that spectacle. One of the mariners said that the old man was an hydrophobid, or had the disease causing the fear of water, and had lately been bitten by a mad dog. I asked —— did they intend his death? 'Nay, rather,' said the mariner, 'he shall presently return whole; and such is the blessing of the sea, that such a kind of madness it will presently cure.' I offered them some money to take me along with them, as a companion and witness. ——, two men withdrawing the end of the sail-yard, lifted up the top thereof, and bore the old man on high; but thence they let him down headlong into the sea, and he was under the water about the space of a *miserere*, whom afterwards they twice more plunged, about the space of an *angelical salutation*. But then they placed him on a smooth vessel, with his back upwards, covered with a short cloak. I did think that he was dead; but the mariners derided my fear, for, his bonds being loosed, he began to cast up all the brine which he had breathed in, and presently he revived. He was a cooper of Ghent, who, being thenceforth freed from his

madness, lived safe and sound. Also the mariners did relate that the Dutch, by a raw herring salted, applied to the bite of a mad dog for three days' space and renewed, do take away all fear of madness. When this has been neglected, at least by the beheld manner of plunging they are all cured." Helmontii, *Ad Not. Oper. Phys.*, p. 62.

Pliny, in common with many other writers, has given credence to the absurd and unfounded belief that there is a small worm in a dog's tongue known to the Greeks as *lytta* (rage or madness), and that if this worm be taken away from a pup, the dog will never become mad or lose its appetite. This worm, after being carried three times round a fire, was given to persons who had been bitten by a mad dog, in order to prevent their becoming mad. Strange to say, this removal of the "worm" from the dog's tongue, or "worming," as it is called, has been practised from the days of Pliny, and perhaps earlier, even to our own time. The same author also informs us that the flesh of a mad dog was sometimes salted and taken with the food as a remedy for the disease, and that "so virulent is the poison of a mad dog, that its very urine even, if trod upon, is injurious, more particularly if the person has any ulcerous sores about him," and that "the proper remedy to apply in such a case is horse-dung, sprinkled with vinegar, and warmed in a fig." "When a person has been bitten by a mad dog, he may be preserved from hydrophobia by applying the ashes of a dog's head to the wound. These ashes are very good, too, taken in drink, and hence some recommend the head itself to be eaten in such cases." "There is beneath the tongue of a mad dog a certain slimy saliva which, taken in drink, is a preventive of hydrophobia. But much the most useful plan is to take the liver of the dog that has inflicted the injury and eat it raw, if possible. Should that not be done, it must be cooked in some way or other, or else a broth must be taken prepared from the flesh."

Pliny was, moreover, a staunch supporter of the practice of cauterization, even holding that it was efficacious after the disease had made its appearance. Columella, who lived about the same time as Pliny, refers to "rabies," and says that it was believed among the shepherds that if the last bone of the tail was bitten off on the fortieth day after the birth of a

pup, the sinew following with the portion thus removed, the tail would not grow, and the dog would be secured from disease. This absurd and barbarous custom is, in like manner with the one mentioned above, practised to this day; but it is now recognised as cruelty in our courts of justice.

Vegetius Renatus mentions rabies with other maladies which affect the lower animals, and advises that cattle which have been wounded by a mad dog should have the boiled liver of the dog given them to eat, or else that it should be made into balls and forced down as a medicine.

In Britain the disease has probably occurred from the earliest times. An Anglo-Saxon manuscript entitled "Medicina de Quadrupedibus," of Sextus Placitus, written apparently at the beginning of the 11th century, is of interest. In it we find a receipt for "tear of mad hounds" as follows:—"Take the worms which be under a mad hound's tongue, snip them away, lead them round about a fig tree, give them to him who hath been rent; he will soon be whole." It will be seen how very similar this prescription is to that mentioned by Pliny, and indeed it is remarkable how widely diffused over the world this superstition has been.

In the thirteenth century, Albertus Magnus alludes to the disease and its appearance in horses. In 1271 rabid wolves invaded the towns and villages of Franconia, and attacked the herds and flocks, and thirty persons died from the bites. In 1748 many oxen and swine in the county of Fife, Scotland, suffered from the bites of mad dogs. In 1752 several mad dogs were observed about St. James's, London. Orders were issued to shoot all which appeared there, and in some country towns similar orders were given. In the nineteenth century the disease seems to have become much more frequent than before, especially in, France, Germany, and England.

In the winter and spring of 1837 rabid foxes were killed at Ulm. The foxes attacked people in the woods or on the public roads, and even entered villages. Every kind of domestic animal, including even fowls, and badgers were also infected. In some places all the foxes died, and so many people suffered that there was a panic among the villagers. In 1804, at Crema, in Italy, a mad wolf descended from the mountains in November and bit thirteen persons, of whom nine died.

From June, 1843, to July, 1844, an epizoöty, which was in all probability one of rabies, spread among cattle in the neighbourhood of Heyden, Rheinland. The rabid animals ran, with heads tossed up and wild looks, madly round the pastures, goring and striking at all other animals with their horns, and they bellowed continuously, so as to strike all hearers with terror. They foamed at the mouth, and the hind quarters grew more and more weak, and so rapidly that, usually on the third day, the animals were stretched on the ground. If at large, they rushed straight on over everything, until they fell over some obstacle, and lay still, apparently exhausted. Any fluids poured in the mouth were sucked down, but a motion as of choking was observed, and a twitching of the muscles of the face. Most of them died about the end of the fourth day, and Dr. Adolphi considered this to be an instance of spontaneous rabies, as no mad dog could be discovered to have been implicated in the infection.

In 1851 a mad wolf near Hue-au-Gal, in France, bit in a single day forty-six persons and eighty-two head of cattle. One person died after another in frightful agonies. As for the cattle, they were purposely destroyed.

In 1856 rabies prevailed in England to a great extent at Stainborough, near Barnsley. The disease was transmitted to a herd of deer, probably in the latter part of 1855, very soon after one or more mad dogs had roamed about the vicinage. About one hundred deer and six dogs died. These ordinarily innocent and playful animals foamed at the mouth, and, like dogs, worried each other, tearing the hair and flesh, and when in confinement bit at whatever came within their reach. In the same year rabies broke out in a flock of sheep at Nuffield, in Berkshire. A strange dog was found by the farmer's son, and beside it two ewes were lying dead, and two others so badly injured that they were afterwards killed. The dog on being pelted with stones ran away. About twenty more sheep were wounded more or less in the regions of the nose and ears, and they were therefore placed in a fold by themselves. Two or three weeks afterwards several of them showed symptoms of madness, and fifteen of them lambed, the lambs being brought up by hand. Those ewes which became rabid trotted backwards and forwards by the sides of the fold, biting at the hurdles, tearing mouthfuls of wool from

one another, and foaming at the mouth. Twenty-two died afterwards. The dog, together with other dogs which had been attacked by it, was shot.

In 1861, Dr. Fleming informs us (*vide* page 50, *Rabies and Hydrophobia*) that, while he was quartered at Tientsin, near Peking, North China, the native Chinese suffered from rabies resulting from the bites of rabid dogs, and that he was assured that, in some parts of the Flowery Land, the belief exists that a man affected with rabies is *enceinte*, and perishes because he cannot be delivered.

About 1862 Sir Samuel Baker, exploring the Nile tributaries of Abyssinia, informs us of the existence of rabies in an epizoötic form in that part of Africa. Referring to page 164 of "The Nile Tributaries of Abyssinia" we read :—"One night we were sitting at dinner, when we suddenly heard a great noise, and the air was illumined by the blaze of a hut on fire. In the midst of the tumult I heard the unmistakable cries of dogs, and, thinking that they were unable to escape from the fire, I ran towards the spot. As I approached, first one and then another dog ran screaming from the flames, until a regular pack of about twenty scorched animals appeared in quick succession, all half mad with fright and fire. I was informed that hydrophobia was very prevalent in the country, and that the certain preventive from that frightful malady was to make all the dogs pass through the fire. Accordingly an old hut had been filled with straw and fired, after which each dog was brought by its owner and thrown into the flames."

In 1866 thirty-six deaths were reported as resulting from hydrophobia; and in 1867 a Metropolitan Streets' Act was passed, whereby the police were empowered to seize all vagrant dogs. In June, 1868, it was put in force, and the number of cases of rabies soon greatly diminished in and about London.

Towards the middle of 1870 the authorities were obliged to order all dogs to be confined in the district of Windermere, Cumberland.

In 1872, having regard to the wide prevalence of rabies, the Duke of Rutland would not allow any bitches to be sent to the stud hounds at Belvoir; and the Hon. G. Fitzwilliam gave similar orders with regard to Milton, and he would not permit

hounds to be sent to other kennels. The serious outbreak which occurred in this year spread widely as a result of the insufficiency of the police measures. Our readers are fully aware of the epizoöty which has recently prevailed in England in 1887 and the early part of 1888.

Symptoms of Rabies in the Ox.—An ox suffering from rabies manifests a diminished or depraved appetite, prostration, a restless excitability, muscular tremblings, a nearly constant flow of saliva from the mouth, a difficulty in swallowing, disagreeable sensations in the seat of the wound, and hallucinations. There are paroxysms in which the eyes stare brilliantly and look inflamed, while the pupils are dilated, and the mouth is hot and foamy, and the voice dull and hoarse. The animal bellows frequently, agitates its jaws, scrapes the ground with its fore-feet, throws behind it the earth or the litter, falls down and rolls, and if tied up tries to get away for the purpose of rushing to and fro.

The secretion of milk is suspended in the case of milch cows, and frequently the animals attack other animals and men. They strike with their horns, or foreheads if they have no horns, at any obstacles in their way with such great fury that their horns are fractured, and the forehead may present the appearance of a mass of blood. They only very rarely try to bite. They cease to chew the cud. The feces, at first expelled at long intervals and in small quantity, become at a later period liquid, and are often passed involuntarily, though at other times the rectum itself may be protruded, owing to the energetic attempts made to expel its contents. The animal becomes extremely emaciated, and at last paralysis of the posterior extremities ensues. The cattle then lie down, and are not capable of getting up, and finally they perish in a state of profound coma. The disease, in the case of the ox, seldom lasts for more than four to seven days, and, as in other creatures, it is always fatal.

In regard to the subject of rabies in ruminants we think it well here to add some observations extracted from the *Lancet* of September 15th, 1888. It appears that the paper from which the remarks were taken was inserted in the *Journal Officiel* of August 27th, 1888, and the author of it is M. Pion, veterinary inspector of the slaughter yards at La Villette. This veterinarian states that as a rule, when bovine animals are afflicted with rabies, the disease does not possess either

the violence or the intensity which characterises the rabies of dogs. Indeed, this malady in the ox is not quite so dangerous as it was formerly supposed to be. Moreover, certain symptoms (not unlike those of rabies) which may be met with in the ox may be erroneously supposed to be those of rabies. The late M. H. Bouley, in his work on Rabies in the Bovine Species gives the symptoms as observed by him in 27 cases somewhat as follows :—

First Day.—The animal seems to suffer slight colicky pains, and, if he lies down, almost immediately gets up again. The senses are excited, the temperature rises very suddenly, and itching pains are felt at the seat of the bite.

Second Day.—The animal is not so greatly agitated, strains slightly, and the temperature of the body as well as at the seat of the bite becomes lower.

Third Day.—There are signs of commencing paraplegia. The animal strains greatly, and discharges fecal material which is covered with mucus of a yellowish-brown colour. There is loss of sensitiveness of the vertebral column, the temperature diminishes, and these symptoms are accompaned by bellowing.

Fourth Day.—The animal suffers from complete paraplegia, strains violently, discharges excrement which is covered with frothy mucus, foams at the mouth, and bellows still more frequently.

Fifth Day.—The same or very similar symptoms are manifested. The temperature becomes considerably lower, and bellowing is not so frequent. The sense of taste is not impaired.

As for the average period of incubation, it was from three to six weeks in about three-fourths of the twenty-seven oxen (out of a herd of eighty) which had been infected by the same dog. In the others it lasted from six weeks to three months. All treatment was futile. The only lesions which were observed after death were on the spinal marrow, which was redder than it usually is in healthy animals, and it was also dotted, especially at about the level of the loins, with numerous spots in the form of lentils. In other parts nothing particular was noticed. Inoculations practised on rabbits with the saliva and with portions of the bulb, diluted, gave rise to rabies in those animals.

A rabid dog may bring about an immense amount of havoc among sheep. Mr. Harris stated that thirty sheep died within three weeks after being bitten by one mad dog, and nearly all which had been attacked expired before the end of the seventh week. As a rule the disease appears in sheep before the close of the second or at any rate the fourth week ; but it has been known to remain dormant until the eleventh week after the bite has been inflicted.

After having been bitten by a rabid dog, the sheep follow one another about a great deal for a day or two, during which they lose condition, although they do occasionally eat their food. Then they look dull, and the ewes may become paralytic and die almost without a struggle. The lambs have a series of convulsive seizures, in which, after a day or two, they die. When afflicted with this disease, sheep are very thirsty, though perhaps not so insatiably as rabid dogs often are in the later stages of the disease, and they do not exhibit any fear of water.

They strain constantly, they are weak in the loins, and palsy subsequently manifests itself. An ox suffering from rabies does not bite, and the sheep also very rarely displays any tendency to do so. Sheep, however, when afflicted with rabies, are very irritable, and if they are provided with horns, they make frequent and violent use of those appendages.

Wethers and rams especially, and occasionally ewes, when affected with rabies, exhibit more or less ferocity. It is true they do not try to bite; but they will nibble at a stick presented to them, and they will attack one another, and run violently against anything which may be within reach, and indeed, may carry this headstrong impetuosity to such an extent as almost entirely to strip the skin from off their foreheads. Moreover, a mucous discharge flows from the nostrils, a ropy saliva from the mouth, and froth collects at the corners thereof. Sheep affected with rabies may devour a large amount of dirt, nibble wood and swallow the pieces, drink very filthy water; and, in fact, they seem to be in some measure unconscious. Just as a rabid dog gives utterance to a howl which is characteristic, so, too, does the sheep, and especially the lamb, bleat in a peculiar manner, *i.e.* they produce a higher note and a more plaintive tone. Some sheep die on the second or third day; more usually the fatal result occurs about the fifth day; a few survive the fifth, and these few frequently exhibit symptoms characteristic of inflammation of the brain.

In this connection we may here insert the leading particulars of an account of an attack of rabies in sheep as reported by Messrs. C. Gresswell and Gibbings in the 22nd volume of the *Veterinary Journal*, 1886, page 411. It appears that these veterinarians were asked to see some sheep which had been bitten by a dog supposed to be affected with rabies. The dog had been shot previous to their arrival, and they were thus enabled to make a post-mortem examination. The larynx and stomach were slightly congested, and in the stomach nothing was present except such foreign substances as grass and earth. The dog, strange to the neighbourhood, had visited three farms in a semicircle, bit one ewe and lamb on the first farm, several on the second, and several more on the third. Altogether about twenty sheep were bitten. Judging from the appearance of the wounds, the bites must have been short sharp snaps. It seemed that the dog had no sooner bitten one sheep than he left it and attacked another, evidently having tried to bite as many as he could, and he had invariably made the face the point of attack. Now, it cannot for a moment be supposed that the dog's object was to satisfy his appetite, for, if so, instead of worrying and biting several sheep on the face alone, he would doubtless have killed a single lamb, and thereupon have proceeded to satisfy his pangs of hunger. Again, having

regard to the fact that the horn of the dog's toes was considerably worn, it was inferred that the animal had travelled some distance, presumably in great measure owing to his rabid state. Moreover, being a small terrier, he could not have been accustomed to worry sheep, as, if he had displayed such propensities, he would in all probability have been previously noticed and killed. Besides, his enmity did not seem to extend so far as actually to try to kill the sheep. From these considerations it was concluded that the dog had been afflicted with rabies, and this diagnosis was afterwards proved to be correct by the fact that on the 14th, 15th, and 16th days after they had been attacked, the sheep (ewes and lambs) were in some cases affected with rabies. Two flocks had been submitted to this dog's bites on two successive days. Fourteen days after the first flock was attacked, one ewe became restless, ate nothing, ran after the other sheep, and butted at them. At first sight she appeared to be under the influence of great sexual excitement, but the continued and determined manner in which she charged at almost every sheep in turn, and the short time spent in the attack in each case, seemed to indicate clearly that she suffered from some affection of the brain. She was isolated and then all these symptoms disappeared, and a dull lethargy supervened. However, on putting her back with the other sheep, she again pursued the same tactics. These symptoms lasted for two days. On the third day tetanic spasms were manifested, together with frothing at the mouth, intermittent inversion of the eye-lids, and occasional severe rigidity of the whole muscular system. On the fourth day she was destroyed. Another ewe became similarly affected on the 15th day, and two more and several lambs on the 16th day. Out of the first flock, six ewes and four lambs were bitten, and of these, five ewes and all the lambs were either killed or died. In all cases out of the first flock, the affected sheep showed symptoms similar to those of the first ewe above mentioned; but in most instances the tetanic spasms appeared earlier, and generally on the second day.

In the case of the second flock, the ewes and lambs which were bitten were twelve in number. Of these, one ewe and two lambs died on the third day. These three deaths, however, were attributed to the extensive lacerations of the head which they had sustained. On the 15th day one ewe was affected with rabies, and only a second case occurred, which was on the 16th. The immunity from rabies which this second flock showed was peculiar. The two flocks were a mile and a half apart. The first was attacked late in the afternoon, the second (very evidently) early on the next morning. At any rate they were found at 6 a.m. in a distressed and frightened condition, while the dog was only half a mile distant from them. It may have been possible that the second flock was not inoculated with virus of sufficient quality or quantity to have produced rabies, or the first flock may have exhausted the supply.

If an examination be made after death has occurred in the case of a sheep, it may be evident that there has been some inflammation of the membranes of the brain, together with slight congestion of its substance. The upper part of the windpipe of the sheep is not always inflamed, as it so generally is in the case of the dog. The chief signs which are diagnostic of the disease are that the rumen is partially filled with dirt and filth, sticks, and stones, a very fetid smell being perceptible, and the inner lining of the paunch being much inflamed, not con-

tinuously, but in patches, and small spots of extravasated blood being seen. These signs of the disease, however, may be absent.

Now, with regard to the measures to be taken, the first point is that all animals whatsoever which are afflicted with rabies should be at once slaughtered, in order to obviate the great risk of the transmission of the disease to human beings. On no account whatever must the flesh of an animal afflicted with rabies be sold. It is well known that the virus of this disease as occurring in the ox, horse, ass, and man, and, according to some authorities, that of the hen and duck, has been the means of conveying the disease to human beings. Hence those who have to deal with any rabid animal cannot be too stringently upon their guard.

Although no microbes have yet been discovered in connection with hydrophobia, the presumptive evidence of the existence of them is very strong indeed. If two brains are brought to Pasteur, the one from a rabid animal and the other from a healthy animal, he can decide at once by the aid of the microscope which is the rabid and which the healthy one. In both are seen an immense number of molecular granules; but those in the medulla of the rabid animal are finer and more numerous, and suggest the idea of a micro-organism of extreme tenuity, in shape neither a bacillus nor a diplococcus. They are "dots." As yet they have not, so far as we know, been cultivated outside the living body.

In the course of his experiments, Pasteur found that the saliva of the mad dog did not always give rise to rabies, and that the more virulent matter was situated in the brain and spinal cord. Both forms of rabies, viz. "furious" and "dumb" rabies, arise from the same virus; but experimentally "furious rabies" can be produced from "dumb rabies," and *vice versâ.*

In the saliva of rabid animals the virus is found associated with various micro-organisms, and the inoculations of this saliva can give rise to death in one of three modes.

(*a.*) By the microbe of saliva.

(*b.*) By reason of excessive development of pus.

(*c.*) By rabies.

The medulla oblongata of human beings, as well as that of all

animals which have died of hydrophobia, is always virulent. Rabies communicated by intravenous injection of the virus very frequently exhibits characters which differ considerably from those of furious rabies supervening upon a bite, or after trephining, and it is very likely that many cases of silent madness have escaped observation. In such cases of rabies, which might be termed *spinal*, early paralysis is a common symptom, whilst the habitual fury and rabid barks are absent or but rarely met with ; but, on the other hand, frightful itching of the skin is at times a marked feature.

Experiments show that after inoculation of the poison into the blood-system, the spinal marrow is the part first attacked, the virus locating itself and multiplying there before spreading to other parts. On the 19th May, 1884, about the fourth year of Pasteur's research, he communicated the following observations to the Academy of Sciences.

"The virus of rabies carried from the dog to the monkey, and subsequently from monkey to monkey, grows weaker at each passage. After the virulence has thus diminished by several passages through monkeys, if the virus be carried back to the dog, the rabbit, or the guinea-pig, it still remains attenuated. In other words, the virulence does not go back at one bound to the degree it had in the dog affected with ordinary or street madness. On the other hand, successive passages from rabbit to rabbit, and from guinea-pig to guinea-pig, increase the virulence of rabies' virus. This exalted virulence comes to a fixed maximum in the rabbit. If now transferred to the dog, it remains exalted, and shows itself to be much more intensely virulent than the virus of ordinary street rabies. So great is this acquired virulence, that the new virus injected into the blood-system of a dog unfailingly gives rise to mortal madness."

A logical application of the above results gives us the means of easily rendering dogs refractory to rabies, for we can now prepare and keep at our disposal a series of attenuated viruses of different strengths, some not mortal, preserving the animal economy against the ill-effects of more active ones, and these latter against the effects of mortal ones.

It was not long before Pasteur found that there was no definite period of incubation, in cases in which the saliva of the

mad dog entered the venous system in the ordinary way. If a large dose of the poison entered, the period of incubation would be short. If only a small quantity entered, it might become localised at the seat of inoculation and wither away, or on a more favourable soil it might slowly and surely work its way and develop into madness months later. The difficulty was to find artificial certainty. If the brains of rabbits were inoculated with the spinal marrow of an ordinary mad dog, Pasteur found that the disease was usually fatal on the fifteenth day. But if another rabbit were inoculated from the first, a third from the second, and so on, the period of incubation would gradually diminish with the increasing virulence of the poison. When the number of passages from rabbit to rabbit extended to the twenty-fifth rabbit, the period of incubation was shortened down to eight days, and after the next twenty-five passages from rabbit to rabbit it became shortened to seven days. At the ninetieth passage the maximum of virulence was attained with the corresponding incubation of seven days, and with a certainty which would be rendered absolute by preserving the rabbits in perfect health and by taking them at a uniform age of six months.

It was found that not one out of twenty-three vaccinated dogs which had been bitten by ordinary mad dogs had taken rabies. On the other hand, within two months after the bites, 66 per cent. of the control dogs which had been similarly bitten had become affected with rabies.

According to M. Pasteur, rabies is mainly and essentially a disease of nerve centres. The virus or infective material exists more especially in the medulla oblongata, in certain parts of the brain, and in the spinal cord. The same observer has shown that the injection of a few drops of sterilised fluid containing a small portion of the medulla oblongata of a dog which has died of rabies is sure to cause the appearance of the disease after a period of incubation of about fourteen days. Similarly, the inoculation of a rabbit by trepanning under the dura mater with the rabical marrow of a mad dog always causes the production of rabies in the rabbit after about a fortnight has elapsed. Now, if the virus of this rabid rabbit is passed on to a second, and then if that of this second is passed on to a third, and so on by the same mode of inoculation as above-mentioned, the period of incubation

gradually becomes shorter, and after about twenty-five transmissions from rabbit to rabbit, the period of incubation at length becomes one of only about eight days. After another twenty-five transmissions, the period of incubation drops to seven days, and continues to be seven days, even if the virus is passed on from rabbit to rabbit even to the number of ninety of those animals. Now, the marrow of these rabbits, when carefully suspended in a very dry atmosphere, gradually becomes less virulent, the rate and degree of diminution depending upon the thickness of the particles and the external temperature. The lower the temperature, the longer the virulence is maintained.

M. Pasteur's method is somewhat as follows:—Every day a piece of marrow freshly taken from a rabbit which has died of rabies contracted after an incubation of seven days is suspended in a series of flasks. The air contained in the flask is kept dry by placing fragments of potassium in the bottom of it. Each day a dog is inoculated with the contents of a syringe full of "bouillon," with which a small quantity of the marrow which has been longest in the flasks has been mixed. On the next day the same operation is performed, but with fresher and more virulent matter, and so on until at length the very virulent matter which has only been in the flask for a day or two is used. By these means the dog is rendered incapable of being attacked with rabies, even if the virus be injected under the skin, or even into the surface of the brain by means of the operation of trepanning. M. Pasteur succeeded in rendering fifty dogs of various ages and breeds incapable of taking the disease, and did not fail in a single case.

Upon the 6th day of July 1885 three persons from Alsace called at M. Pasteur's laboratory. Of these one was Theodore Vone, a grocer at Meissengalt, near Schlestadt, and he had been bitten on the arm two days previously by his own dog, which had gone mad. Another was Joseph Meister, a boy nine years of age, who had been bitten by the same dog on the same day. The dog had pinned him to the ground, and had bitten him so badly about the hands, legs, and thighs, in fourteen different places that the boy experienced great difficulty in walking. When picked up, he was covered with foam and blood. At about twelve hours after the accident, the bites had been

cauterised with phenic acid by Dr. Weber. The third person was the mother of Joseph Meister, but she had not been bitten. The dog had been killed by its master, and on examination after death it was found that the stomach was full of hay, straw, and bits of wood. M. Vone was badly bruised about the arm; but, the dog's teeth not having penetrated his shirt, he was advised to repair homewards on the same day; medical friends agreed that he was not in any danger, his wounds being only contused. The boy and his mother were kept at the laboratory.

Drs. Vulpian and Graucher saw the fourteen wounds which had been inflicted on the boy, and they agreed with M. Pasteur that it was next to impossible that he could escape being seized with hydrophobia, and, in fact, that he was most certainly doomed to die from that disease, if no help could be given. M. Pasteur communicated to them the results of his latest experiments, and resolved to try the same method which had been so invariably successful in the case of dogs. It is to be borne in mind that M. Pasteur had also made several dogs impervious to rabies after they had been bitten. The mother also urged her entreaties, and hence M. Pasteur finally agreed to direct the operations of Drs. Graucher and Vulpian. Accordingly, at 8 p.m. on July 6th, sixty hours after the bites had been inflicted, in the presence of Drs. Vulpian and Graucher, beneath a fold of the skin of the boy's right hypochondrium they injected half the contents of a syringeful of suitably prepared marrow which had been taken from a rabbit which had died of rabies on June 21, and had been preserved for the intervening fifteen days in a flask, the air of which had been kept dry. The virus of this marrow had thus been weakened by being dried in air, that is in contact with oxygen for a period of fifteen days. It is not to be exposed to the free atmosphere, where it would undergo decomposition; but it is to be suspended in a jar provided with a cotton-wool stopper at the mouth, and a cotton-wool stopper at an aperture below, which permits the air to pass through, filtered and pure. In order to keep the air dry, some caustic potash is placed at the bottom of the jar.

The following table shows how the progress was made from weaker to more intense virulence, each successive inoculation coming nearer and nearer to the original virus of a rabid dog, and then passing on to the still more intense virulence of a

rabid rabbit. The inoculations were repeated on the following days, namely:—

On July	7,	at	9 a.m.,	with marrow of	14 days.
,,	7	,,	6 p.m.	,, ,,	12 ,,
,,	8	,,	9 a.m.	,, ,,	11 ,,
,,	8	,,	6 p.m.	,, ,,	9 ,,
,,	9	,,	11 a.m.	,, ,,	8 ,,
,,	10	,,	11 ,,	,, ,,	7 ,,
,,	11	,,	11 ,,	,, ,,	6 ,,
,,	12	,,	11 ,,	,, ,,	5 ,,
,,	13	,,	11 ,,	,, ,,	4 ,,
,,	14	,,	11 ,,	,, ,,	3 ,,
,,	15	,,	11 ,,	,, ,,	2 ,,
,,	16	,,	11 ,,	,, ,,	1 ,,

Thus thirteen inoculations were made in eleven days. Two fresh rabbits were trepanned with the various marrows, used so as to coincide with their degrees of virulence. In other words, in order to test the virulence of the poison, corresponding injections were made into two healthy rabbits, as each day passed by. The results showed that the marrow which was used on each of the days, July 6th, 7th, 8th, 9th, and 10th was not virulent, because the rabbits inoculated with it did not go mad. The marrows, however, of the next six days were all virulent. For instance, the rabbits inoculated on July 15th and 16th went down with rabies after a period of incubation of seven days, those inoculated on July 12th and 13th after eight days, and those inoculated on July 11th after fifteen days. Hence it was quite clear that, during at least the last two days of his treatment, Joseph Meister had been inoculated with the most virulent virus—namely, that of the dog reinforced by a number of transmissions from rabbit to rabbit, and one which communicates rabies to dogs after nine or ten days' incubation. In fact, when the stage of immunity is reached, the strongest virus can be inoculated even in large quantities. It was evident that Joseph Meister escaped not only the hydrophobia which his wounds would doubtless have developed, but also that with which he had been inoculated in order to verify the immunity due to the treatment. A very virulent inoculation at the end

has the further advantage of lessening the period during which alarm is felt as to the results of having been bitten.

If hydrophobia were about to make its appearance, it would be hastened by the inoculation of a virus stronger than that introduced by the bite. When the middle of August had come, M. Pasteur felt confident that the boy was out of danger, and when three months and three weeks had elapsed after the accident, his health was very good. Hence M. Pasteur has proved that if rabical marrow is placed in contact with dry air, its intensity is gradually diminished, and finally extinguished. Consequently it would *primâ facie* seem that in the first place virus with no appreciable activity should be used, next virus with a very little strength, and finally the strongest virus. But on more careful consideration this view seems to be a doubtful one. The lessening of the virulence may possibly be due to the diminished quantity of the rabical virus, and not to its diminished virulence. It is a matter of difficulty to decide this question.

Now it is known that many microbes seem to give birth in their growth to matter which has the property of hindering their own development. The microbe found in some fevers seems to be combated by a substance of its own creation, and M. Roulin has shown that the fungus Aspergillus niger develops a substance which checks its growth. It is possible, then, that the rabical virus is formed of two distinct substances, one living and capable of developing in the nervous system, and another not living, but having the faculty of counteracting or even arresting the growth and development of the first. It is impossible to over-estimate the far-reaching importance of this clue, and probably it will be found in the future to lead to discoveries the brilliancy of which as yet we can by no means fully realise.

Before concluding our short review of rabies, we may repeat that all oxen, sheep, dogs, or any other lower animals affected with rabies, must be slaughtered, and their carcases buried with antiseptic precautions. If there is some doubt whether the disease be rabies or not, it is best to have the animal killed, in order to be on the safe side. The untold havoc which a rabid dog may bring about, even in one day's perambulations, is frightful to contemplate, and it is most wise that the muzzling orders should be strictly enforced in all towns and

districts in which rabies has shown itself. This is especially of importance when days are hot; and though we should be very sorry to encourage any feelings of panic, we feel it incumbent upon us again to point out the dreadful, painful, and fatal nature of the malady, in order that all local authorities may be well on their guard.

VARIOLA, VACCINIA, AND VACCINATION.

It is not the least striking fact about the disease "variola," that it probably afflicts almost if not quite all those animals which subserve the domestic purposes of mankind. Not only is man himself liable to be the unfortunate prey of the ravages of small-pox, but in addition the sheep, the horse, the cow, the goat, the pig, the dog, and even fowls, are subject to a malady which is in all essential points identical. In the present state of our knowledge of the science of disease, but little can be said definitely regarding the nature and degree of the connections which evidently exist between the same or similar maladies affecting different kinds of animals. As we have before pointed out, these relationships are at the present time receiving a degree of attention which is becoming very fruitful in its results. The changed activities of human beings have, in common with their more conspicuous consequences, also altered the maladies to which they are subjected, in no small degree. Already much valuable information has been gained; but this is as nothing compared with what yet remains unknown. It is, indeed, very probable that there are not a few instances in which the new conditions attendant upon civilisation have brought in their train diseases not previously met with. One of the great needs of the day is to decide in what manner and to what extent the diseases of animals are connected with those which afflict the different varieties of the human race.

It will be clearly evident to the earnest investigator into the field of pathology that we must look to the causal relations between the diseases of mankind and those of animals, in order to understand completely the maladies which affect any individual group, and at the same time to find out the methods whereby they may be prevented, or alleviated, or cured.

The virulently infectious fever known as variola presents one of the best instances of the incalculable value which attaches

itself to a clear acquaintance with the connections subsisting between the diseases of animals and those of man. It is true that Jenner's great discovery of the principle of vaccination, like many other priceless revelations, seems to have had something of the nature of an intuitive grasping after hidden truth. If, then, with the comparatively limited knowledge of the intrinsic nature of disease possessed at that time, gifted persons could find out such a preventive measure as that of vaccination, how much more is it likely that medical and scientific men of light and leading in these days will be able to trace the many concealed factors which yet remain to be found, and among these the numerous links betwixt the disorders of man himself and those of various animals. Vaccination, in despite of the most reckless and determined onslaughts against it, has been abundantly proved to be most necessary to prevent the ravages of small-pox, a scourge formerly liable at any time to strike terror and dismay and wholesale death into the midst of a community.

Inoculation, without doubt, was practised in Asia long before its employment in Europe. It seems to have been known to the Chinese, and there is a tradition that it began as early as the dynasty of Song, in the year of Christ 590. The practice was kept secret, and probably was not much approved of by the Chinese. They used to take a few dried small-pox crusts and add a little musk and wrap up the mixture in a little cotton wool, and place it in the nostril, so that it could not easily drop out, and they still carry out this custom This method was also practised by the Brahmins in Hindostan, by the Persians, Armenians, and Greeks; but the operation generally was that of scratching or puncturing the skin, and inserting variolous matter into the wound. The Circassians used three needles tied together, and having pricked the body in five different places, inserted variolous matter into all.

Lady Mary Wortley Montague is said to have been the first to introduce inoculation into England. When residing in Turkey in 1717, she found that the old women were wont to inoculate children every autumn, and that the small-pox thus brought on was usually mild. Her son passed favourably through the malady, and in 1722, on her return to England, she submitted her daughter to the same operation, likewise favourably. Dr. Keith followed her example, by inoculating his son, and the

practice soon became rather general. Plumbe states that "shortly after this, Caroline, Princess of Wales, one of whose daughters had recently died and been much disfigured by small-pox, was anxious to have the rest of her children inoculated. Six condemned felons were pardoned by George the First on consideration that they should submit to be inoculated. Five of them contracted the disease favourably, the sixth being not affected. A seventh escaped hanging by having a few small-pox crusts thrust up her nose. Eleven children of the parish of St. James's were also inoculated and did well, and, finally, the Princesses Amelia and Caroline also favourably underwent the operation. In eight years 845 persons had been inoculated, and of these 17 died.

In 1746, the Small-pox Hospital was established for the reception of poor persons suffering from the disease, and for the gratuitous inoculation of people who had escaped it. However, the deaths from small-pox, which for ten years (six prior to, and four subsequent to, the founding of the hospital) had averaged 72½ in every 1000, rose during the next ten years to 103, and in the next to 111.

The scourge of small-pox was by Jenner stripped of its malignancy, and Death halted in the midst of his revellings. In June, 1798, Jenner being satisfied with the result of his experiments, transmitted his MS. to a person in the confidence of Sir Joseph Banks, with the request that it should be laid before him. He received, in reply, an admonition that, as he had gained some reputation by his former papers to the Royal Society, it was advisable that this should not be presented, lest it should injure his credit! However, the great discoverer sent to the press his *Inquiry into the Causes and Effects of the Variolæ Vaccinæ, a Disease Discovered in some of the Western Counties of England, particularly Gloucestershire, and known by the name of the Cow-pox.* Many were at once convinced of the truth of Jenner's opinions.

It is interesting to note that Jenner was led to his discovery by the fact that milkers of vaccinious cows generally escaped small-pox, owing, no doubt, to infection by vaccinia, as was supposed to be the case by the dairymen in Gloucestershire. We must also remark that inoculation with cow-pox before the time of Jenner was never more than a matter of mere accident,

and occurred only with comparative rarity. "It was matter of popular tradition; but was left for Jenner to demonstrate, that persons who had thus been accidentally vaccinated enjoyed immunity subsequently from small pox." (E. C. Seaton.) In the year 1813 a report was published by the Imperial Institution of France, which stated that 2,671,662 subjects had been properly vaccinated in France, and that only seven of these had afterwards taken the small-pox. In Prussia the number of persons who died from small-pox was reduced from 40,000 annually to 3,000.

Although it is not yet settled beyond doubt, there seems to be

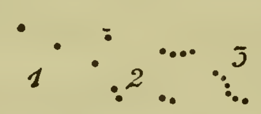


FIG. 37.—MICROCOCCI IN THE FRESH LYMPH OF HUMAN SMALL-POX.
1. Singly. 2. In dumb-bell-like pairs. 3. In short chains (*after Klein*).

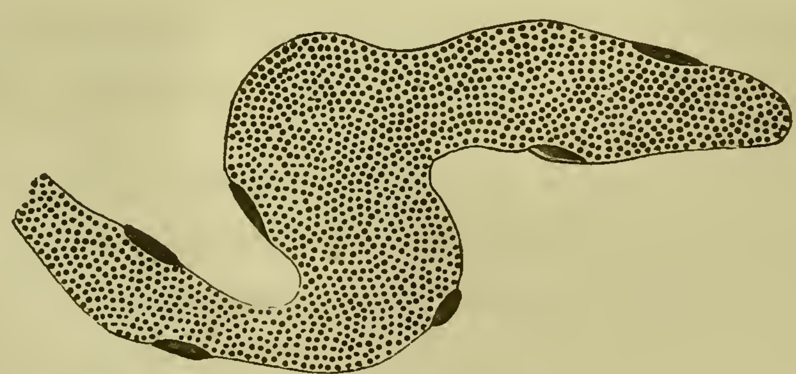


FIG. 38.—LYMPHATIC VESSEL FROM THE SKIN OF A POCK IN THE CASE OF SHEEP-POX.
The vessel is seen to be filled with micrococci.

every reason to believe that variola depends upon the presence of a special and very minute micrococcus. Cohn found that the lymph of vaccinia and that of variola contains numerous micrococci. That the lymphatic vessels of the skin near the pocks are full of micrococci, has been shown by Weigert in the case of small-pox of man, and by Klein in the case of sheep-pox. The passage of these micrococci through the epidermis at the point of vaccination in the calf has been traced by Pohl-Pincus. When cultivated on the warm stage, and subjected to examination by the microscope, the micrococci are seen to form very long chains and colonies. Still, as Dr. Klein points out, similar micrococci occur in the fluid contents of vesicles in the skin

which have been produced by various non-infective inflammations. It is therefore manifest that, in order to make sure that they are the active cause of the disease, it would be necessary to cultivate them for several generations, and with the latest-formed micrococci to inoculate other animals, and then, if the disease makes its appearance in these animals experimented upon, the proof that the micrococci are the exciting cause of the malady would be complete.

The virus of variola retains its noxious powers for a very long period. The symptoms of this malady are acute, febrile, and regular. Betwixt the time of the reception of the virus and the appearance of febrile symptoms, a period of incubation intervenes. If the disease has been produced by means of inoculation, this latent stage lasts about seven days and a half; but if it has been acquired by ordinary natural means, about twelve days and a half elapse before the malady expresses itself.

Small-pox (or Variola) of Man.

Small-pox is a specific fever spreading by infection and contagion, and especially characterised by the appearance on the third day of a papular eruption which gradually becomes pustular, and attains its full development on about the eleventh day of the disease. The eruption is also shown in the mucous membrane of the mouth, fauces, and larynx.

At about the close of the eighteenth century, Jenner's discovery was made, and since then small-pox has not been so markedly fatal. Instances are not at all uncommon in which persons have a second or even a third attack; but such attacks are generally mild. People who have not been attacked for many years, although exposed to contagion, may at last contract the disease in a severe form.

Supposing it to have arisen by inoculation, on the second day a small papule shows itself at the seat of puncture, and by the fourth day this is converted into an umbilicated vesicle. On the seventh day the vesicle has become a pustule, and the lymphatic glands are swollen and tender. On this day, or the following day, rigors and other symptoms occur. About the tenth or eleventh day the pustule is fully developed, and the general variolous rash occurs. By the fourteenth day the pustule has dried up into a scab. The usual period of incubation, when the disease is

20

developed in the general way, is about ten to sixteen days, or we may say that the disease manifests itself at about the middle of the twelfth day.

The incubative stage is not attended with symptoms, or only with slight symptoms. The patient may feel languid and peevish. The first onset is marked by rise of temperature, chills, followed by, or alternating with, heat of skin and copious perspiration, severe sickness, with anorexia, thirst, and constipation (or in children diarrhœa), headache, aching of the limbs, and *intense pain in the lumbar region of the spine*, drowsiness, and sometimes delirium and coma. In children, diarrhœa may take the place of constipation, and convulsions may occur in them. Sometimes there may be maniacal excitement, vomiting, constipation, and acute lumbar pain, with frequent convulsions. The higher the temperature, the more persistent the vomiting, the acuter the pain in the back, and the more pronounced the cerebral symptoms, the more quickly will the disease assume grave proportions. The symptoms usually attain their maximum on the third day, the day on which the characteristic rash first manifests itself.

About the third day after the onset of variola, a papular eruption first shows itself in the form of small reddish solid elevations, each surrounded by a red areola, appearing both on the skin and also usually on the lining membrane of the mouth, fauces, and larynx. These papules gradually increase in number, and are, in a few days' time, transformed into alveolated vesicles, containing a transparent lymph, which soon becomes purulent. At about the eleventh day the pustules attain their full development. Many of them are at first depressed near the centre, but they lose the peculiar appearance which is thereby caused by reason of a subsequent distention of their envelopes with the purulent pus. Afterwards this fluid dries, and then, instead of the pustule, a dark brown crust is formed, which is finally detached, leaving a scar. When these vesicles are numerous, the skin between them is swollen, and when this is the case, the eruption on the lining membranes of the mouth, fauces, and larynx is also more severe. The fever is usually most intense before the eruption manifests itself; but, though it becomes higher as the suppuration advances, it soon subsides, and when the drying up of the pus begins, it disappears. Of course, in very bad cases, and especially if

pyæmia sets in, the febrile symptoms become very strongly marked.

Having now considered variola generally, we proceed to deal firstly with bovine variola, or vaccinia, and then with vaccination.

Bovine Variola, or Cow-pox, or Vaccinia.

This contagious disease probably affects cattle in every part of the earth, and has prevailed in the form of epidemics in every country of Europe. Its power of protecting mankind from small-pox has been known for a long time. In hot countries, such as India, the pustular eruption, which is generally limited to the udder, may be more or less general over the body. Animals kept in stables appear to be more generally attacked than those which are out at pasture. Probably this arises from the greater liability of contact. The disease seems to be more frequent in spring than at other seasons. After calving, when the mammary gland has an increased supply of blood, the cow apparently has a greater liability to the malady. In the general way cows alone appear to be affected. Probably the disease occurs in male oxen; but is not so likely to be noticed in them in consequence of the absence of the udder, an organ to which, owing to cows being used for milking purposes, much attention is necessarily directed.

If cow-pox arises, as some have thought, from human small-pox, it is not difficult to see the reason for this. Whether cow-pox may arise independently of other animals and man or not, at any rate it seems to be established beyond doubt that they may get it from the direct contact of the hands of a milker who is suffering from small-pox. Male oxen are susceptible to the disease by inoculation. Moreover, the disease may arise by means of the virus of horse-pox conveyed by attendants, and probably, also, by association with horses in stables and pastures. At least, this is said to be the case; but we may point out that a great deal of investigation is needed before such points as these can be considered to be cleared up.

The rash of cow-pox, as we have said, chiefly affects the udders and teats of cows, being manifested by the development of small, pale-red hard nodules or pustules, which vary in size from that of a pea to that of a haricot bean. These pass through stages altogether similar to those which characterise

the pustules of small-pox. Like them, they begin as papules which in a few days are converted into vesicles containing a viscid yellow fluid. These vesicles gradually increase in size, until in about eight and a half days they are about five-eighths of an inch in diameter. In the middle they have a light-blue tint; but towards the margin they are reddish-blue or yellow in colour. Their contents then become purulent. The centre is usually depressed, and a crust begins to form there, and gradually extends to the periphery. The border is hard, swollen, and painful, and a red areola forms, together with much thickening under the skin.

About the fourteenth day a scab, which is thick, dark, adherent, and shining, is formed, and about the fifteenth day it becomes detached, leaving a depressed scar, which is at first bluish-red, and gradually turns pale, and persists for a long time. The febrile symptoms are very slight, and generally unimportant, and the infection is not a dangerous one. A partial loss of appetite, an abstention from chewing the cud, trifling constipation, diminution and deterioration of the milk are to be observed. The udder is swollen, especially near the teats, and milking causes pain. There may be more than one eruption of pustules.

Cow-pox generally lasts about seventeen and a half days, but may be protracted for about five weeks. The vaccine matter for vaccination purposes is generally collected at about the fifth day after the first appearance of the pustule. The course of the malady is usually favourable, at least in western countries. The milk should not be used for human food, so long as the cow is suffering. The disease may be conveyed by contact from cow to cow, by the hands of milkers both from one cow to another, and also directly from small-pox pustules of the attendants, or by injection of the virus into the blood-vessels, or by ingestion of it through the mouth. It will be clearly seen that the animals which are affected should be milked last, in order that the virus may not be taken from cow to cow. Perfect cleanliness in all points, care in milking, and suitable treatment of any secondary local results must be thoroughly attended to.

Messrs. Cecly and Badcock inoculated cows with small-pox lymph, and the result was that at the seat of inoculation pustules exactly like those of cow-pox were produced. Moreover, with the contents of these they imparted cow-pox to healthy cattle,

and to the human being an affection exactly like that brought on by ordinary vaccination. It seems highly probable that cow-pox is nothing else than small-pox communicated to the cow from man, and thereby deprived of its virulence. In support of this view, the fact that cow-pox, when inoculated from cow to cow, tends before long to die out, presents itself for consideration.

Vaccination.

When the material of cow-pox is inoculated on a human being, about the end of the second day or the beginning of the third day a small congested papule appears. This papule gradually increases in size, and about the fifth day becomes a circular greyish vesicle, with a depressed centre. About the eighth day it is largest, has a cupped surface, and contains a colourless and transparent viscid fluid, which about this time begins to become purulent. A red areola forms, and some thickening of the inflamed area occurs, and increases until the tenth day. The areola also attains a diameter of about two inches. At the close of about ten and a half days the pustule begins to dry up, and the areola and other signs of inflammation to subside. At about fourteen and a half days from the outset, a hard and dark-coloured scab has formed. This blackens, and at about twenty-two and a half days from the beginning falls off, leaving a depressed, pitted, permanent scar.

In association with these local changes, there is also manifested a rise of temperature, even sometimes on the fourth day; and at a later time, for instance, from the eighth to the tenth or eleventh day, together with the development of the areola, the temperature rises still higher, and there is much restlessness, and loss of appetite. The glands above the seat of the operation are enlarged and painful, and sometimes a roseolous rash spreads over the vaccinated limb, and perhaps to other parts. This rash may be vesicular or papular. The consequences of vaccination direct from the cow are identical with those resulting from vaccination with humanised lymph. If a person is re-vaccinated, there may be merely a little local irritation or a development of the typical pock. The papule may attain its full development about five and a half days after the operation, and very soon afterwards form a scab, which falls off in the course of a day or two.

The first recorded epidemics of small-pox occurred in the sixth century. Early in the eighteenth century the disease was deprived of a great deal of its terrors by reason of the practice of inoculation, which was at that time introduced into this country by Lady Mary Wortley Montague, who had seen the efficacy of the method in Constantinople, to which place it had been imported from Persia and China. In the latter half of the same century a belief in the protective power of cow-pox against variola seems to have been entertained in Gloucestershire. It is said that a schoolmaster named Plett, in Holstein, vaccinated two children in the year 1771; and it seems to be established than an English farmer named Benjamin Jesty performed the same operation on his wife and two sons in the year 1774. The value of vaccination was, however, first really proved by Edward Jenner, whose first publication on this subject appeared in 1798.

In the ninety-one years which have elapsed since that date the practice of vaccination as a preventive of small-pox has been adopted throughout the whole civilised world. Experience has shown that successful vaccination is as protective against subsequent attacks of small-pox as an attack of that disease itself is. Where vaccination is in vogue, small-pox has become comparatively rare and unimportant. The protective influence of the vaccine matter is not diminished by its continued transmission from man to man. The immunity becomes less sure as years pass by; but if a person who has been vaccinated does contract small-pox, the disease is as a rule mild, and but very rarely fatal. The mortality among those suffering from small-pox who have not been vaccinated has been found to be as much as 37* per cent., whereas of those who had as many as four or more vaccination marks the mortality was only 0·55 per cent.; and even among those who were said to have been vaccinated but had no cicatrix, the fatal cases were in the proportion of only 23·57 per cent. These results were obtained by Mr. Marson, and represent an experience of twenty years at the Small-pox Hospital in London, collected from an examination of 5,000 cases. It has, however, been held that syphilis, scrofula, and perhaps other diseases may possibly be imparted

* In Seaton's account of Marson's work, I find 35 per cent. instead of 37.

by vaccination. The recorded cases are, however, extremely rare, and those few which are really due to this cause are no doubt attributable to some carelessness.

It is legally enjoined that every child shall be vaccinated within three months after birth. The operation ought to be repeated about the age of puberty, and persons who are liable to be exposed to the contagion of small-pox should be re-vaccinated, unless they have very recently successfully undergone the operation. The lymph to be used for vaccination should on no account be taken from persons who are either known to be diseased, or suspected to be suffering from any disorder, nor from *pocks* which are ill-developed or purulent, nor from those produced by re-vaccination. Good lymph is yielded by normal pocks from about the fifth to the eighth day after inoculation, and that of later date should never be made use of. The vesicles are to be punctured with the point of a lancet, care being taken to avoid bleeding, and the fluid which exudes may either be used at once, or preserved in capillary glass tubes. The vesicle should not be squeezed. Lymph may be diluted with glycerine in the proportion of about 1½ parts of that fluid to one part of lymph.

Vaccination is generally performed on the upper and outer part of the upper arm. Groups of parallel or crossed scratches or fine punctures may be made, so as to allow of a little oozing of the blood. This latter is to be wiped away, and then the surface is to be anointed with the vaccine lymph. If the lymph has been preserved in the dry condition, it is essential that it should be first well moistened with a little water. If no result follows the operation, it should be repeated.

Our readers will see that though cow-pox is not a disease of very great importance in its relation to oxen, it is still one of the utmost interest and moment, when looked upon from the standpoint of the welfare of the human race. As we have intimated, the probability is that the virulent disease known as small-pox of man, when communicated to cows by the medium of milkers or by inoculation, loses a great deal of its power for mischief—indeed, to such an extent that when again inoculated upon man it merely gives rise to transient symptoms, which, however, protect against small-pox.

We now come to the consideration of "Small-pox in Sheep"

above mentioned. This disease is known scientifically under the name of *Variola ovina.* On this subject a treatise by Professor James B. Simonds, sometime Principal of the Royal Veterinary College, Camden Town, London, N.W., was published in the year 1848. From this valuable work we have gathered many of the observations which follow.

This very destructive disease occurs in most parts of the Continent, where it frequently assumes an epizoötic character. The first outbreak in England was probably that of the year 1848, when the disease resulted from the importation of infected animals from abroad.

Rammazini records that at Modena, in 1690, the season was cold and moist, and that the distemper of that year attacked all the people who lived in the country, and spread among all kinds of animals, killing great numbers after a few days' illness. A discharge appeared on the thighs, neck and head, resembling the pustules of small-pox; and most of the animals which had this appearance lost their eye-sight, and those which did not die lost flesh. He spoke of this disease as being the small-pox, the pustules being similar in form, colour, mode of suppuration, and disappearance. This epidemic continued in 1691, attacking chiefly the sheep.

In Picardy small-pox broke out in the year 1746, and continued up to 1792, destroying hundreds of sheep every year during that interval. Moreover, Rabelais and Joubert mention the occurrence of *clavelée* (sheep-pox) in France in the sixteenth century; and since then, in many parts of that country, there has been great destruction among the flocks, particularly in 1816. Hurtrel d'Arboval affirms that since it was first observed this disease has broken out as an epizoötic at intervals of about twelve and a half years or so, and Captain Carr has recorded that small-pox of sheep often appears in different and widely-separated localities of Germany. Sheep-pox is supposed by many to have originally come from Asia, and, in like manner with small-pox, to have gradually extended from Asia to the continent of Europe.

On September 4th, 1847, Professor James B. Simonds was consulted with reference to a destructive skin disease which had broken out among the sheep of Mr. Statham, a farmer of Datchett, near Windsor. He had bought fifty-six sheep of the

Spanish breed in Smithfield Market on the 26th of July. After a week the sheep were put on the same pasture as that on which a flock of about 200 Downs were grazing. A few days afterwards Mr. Statham saw one of the Spanish sheep standing apart, and that its body was covered with eruption. On the next day several more of the Merinos were found to be similarly affected, and then the disorder spread continually, and many of the sheep died. About a fortnight after the two flocks were pastured together, the malady first appeared among the Downs, which seemed to suffer more severely than the Merinos. The flocks were then separated; but still the disease continued to advance, and losses occurred daily.

It is not difficult to understand how the disease was introduced, seeing that in some localities on the Continent, for instance round about Paris, it is probably only very seldom indeed that no traces of the disease can be found. Again, it is said that in Hamburg market a separate place was assigned to contaminated sheep and those which had come from places where the disease was known to exist. Seeing that the affection lies dormant, or rather in an incubative and not evident form, in the system for many days, it is not surprising that infected animals should have been brought into England and sold without any suspicions being excited.

In order to avert the disastrous outbreak, which it was clearly evident must occur, unless the most stringent measures were taken, a letter was sent to the authorities of the Board of Trade stating that a disease similar to small-pox of man had broken out in sheep in this country, that it had destroyed many sheep in every flock attacked, and moreover that it would spread far and wide unless isolation of the diseased animals was enforced, the necessity for this course being seen in the circumstance that infected sheep were often exposed for sale in Smithfield Market, and finally that the malady had been introduced from Tonningen and Hamburg.

It was determined that a more careful examination of all imported sheep should be carried out by veterinary surgeons duly appointed as inspectors, so that no animals that were actually diseased should be landed. If quarantine were established, sheep would require to be examined every day for a fortnight, and if any were found to be diseased, all on board ought to be forthwith

slaughtered, and the pens, sheds, and so forth thoroughly disinfected, before any fresh sheep could safely be allowed to occupy them.

Professor Simonds suggested that veterinary surgeons should be appointed as inspectors at every port where sheep are landed, to examine the animals before they are removed from the ships. If any should be found to be affected with variola, they should be immediately slaughtered. Moreover, all the sound sheep which had been thus exposed to the contagion during the passage should be sent to the meat markets, the carcases of the diseased being buried and their skins burnt, the loss being borne by the importers. A market should also be set apart for the sale of foreign sheep and cattle, and be holden weekly at each place of importation. To these markets all those animals which had passed the inspectors should be sent, and all the sheep which should arrive in the intervals between market days, and those which were unsold, should be specially located, so as to prevent them from being mingled with English sheep. Purchasers should be enjoined to have the sheep, bought by them, killed without delay, or, at any rate, kept stringently isolated for a period of three weeks, during which time they should be examined, and if they were found to be diseased, the fact should be at once notified to the authorities.

In regard to the breaking out of sheep-pox in England, we have first to say that on October 1st, 1847, information was sent by the Government to the Lord Mayor concerning the measures which had been determined upon. On the next market day—October 4, 1847—twenty infected sheep were taken into the possession of the police-officers of Smithfield. At first the vigilance of the city magistrates and of their officers did not entirely repress the slaughtering of infected sheep in the country and the sending of their carcases to London ; but in the course of a few weeks this practice, as well as the sending up of living sheep afflicted with the disease, was almost entirely stopped.

Now, in reference to the characters of the malady itself, sheep-pox, like human small-pox, is very infectious and contagious, and both diseases are characterised by a particular kind of acute inflammation of the skin and mucous membranes of the entire body, coupled with fever, and to be very similar to each other. So liable is sheep-pox to spread, that it is highly

dangerous even to drive a healthy flock on a road over which diseased sheep have travelled a short time before, and there is especially great risk of the malady being transmitted by means of the wool. Young sheep are more likely to be attacked than older animals, but when infected they do not suffer so markedly.

The symptoms of the malady first manifest themselves in sheep about ten days after they have been subjected to the poison, provided the weather be warm; but in cold weather twice that period may elapse, and, moreover, the malady will then be less destructive than it is when the outside air is warm and humid. The next stage, that of papulation, occupies about six days. The sheep become dull, and lose their appetite; they like to take water and to lick earth; they cease to chew the cud, have a staggering gait, slight fever, and a mucous discharge from the nostrils, which becomes thicker and even bloody as the disease advances. The respirations are quick and short, the mucous membranes are inflamed, and the conjunctival lining of the eye-lids is red or scarlet. The eye-lids themselves are swollen, tears flow in profusion down the face, the ears are pendent or lopped, the head is held low. The infected animals separate themselves from the herd, and keep apart; some stand looking dejected, while others lie down in a remote corner of the field.

At first the bowels may be torpid, but afterwards diarrhœa may come on. The pulse is quick, and may number as many as ninety-five beats per minute, and be almost imperceptible. About three and a half days after the onset, both in the case of the natural disease and also when it has resulted from inoculation, there may be a diffused redness of the integument a day or two before the spots appear. This redness is very similar to the one which breaks out in human beings suffering from small-pox. As this redness subsides, small red or purple points appear, and gradually attain to about the size of a lentil. These deeply embedded spots are best seen in places where the covering is hairy rather than woolly, on the inside of the arms and thighs, especially between the inside of the shoulder and the breast, on the face and hips, the under surface of the tail, and so forth. These spots or papules are under $\frac{1}{8}$-inch in diameter, they are flattened in the centre, and surrounded by a red ring.

In the papular stage of the disease the wool may become

detached. Some of the papules meet so as to be confluent. The eruption rapidly extends over the whole skin, either in a discrete or in a confluent form. It is said that Down sheep seem to be particularly liable to have these papules on the face, in which case the malady is very fatal. These spots impart a sensation of firmness when they are pressed upon; and when they are cut into, the section is not unlike that of a wart. If we try to pass a needle into one of these papules, some difficulty is experienced, and nothing more than about a drop of blood escapes. They are vascular only at the surface. If some of the wool covering the papules is forcibly detached, the exposed papules become white and then red again. These papules may unite, and thereby produce prominent growths on the skin, something like a bunch of grapes in appearance.

At the same time as that at which this eruption is manifesting itself, the sheep refuses food, and refrains from noticing companions or surrounding objects. The disturbance arises apparently at the same time both in the mucous membranes and in the skin, the mucous membranes or inner linings of both the respiratory and the digestive systems being affected. The discharge from the Schneiderian membrane of the nose may be thick, and so closely adherent to the sides of the nostrils that even suffocation may be brought about. The pulse is indistinct, and even the heart's beat itself has a vague character; the ears and feet are cold, the wool comes off easily, showing the skin underneath to be inflamed.

The next three-and-a-half days after the formation of the papules are taken up by their becoming vesicular, as is shown by their becoming white and bladder-like. Sometimes the papules meet and become confluent, whereby large accumulations are formed, vesication is delayed, the fever continues, and a fatal result probably ensues.

In the perfectly formed vesicles of the sheep the lymph is not contained in meshes, as it is in the case of the vaccine vesicle of the human subject; and hence, while one puncture is sufficient to evacuate the contents in the former, several are needed in the latter. Some papules disappear without becoming vesicular, and in some vesiculation is delayed.

The next three days are taken up with the stage of suppuration. The vesicle of sheep-pox is flat, that of cow-pox arises

from the papule in an acuminated form, while that of small-pox is depressed in the centre. The contents of the vesicles are at first rather transparent, then milky, then turbid, then straw-coloured, the latter changes being due to the presence of pus-corpuscles. Then the contents become dry, and thus ultimately cast off, together with the scale.

The fever may now assume a typhoid aspect, the discharge from the nostrils becomes fetid, the breathing more rapid and perhaps painful and accompanied with moaning. The cuticle covering the spots becomes brown, and in the case of some it peels off. Pus is formed on the margin of some of the spots. The wool is capable of being very easily separated from the skin, ulcerations of the conjunctiva occur, the internal structures of the eye become disorganized, the animal shrinks from being touched, the pulse becomes still more rapid and imperceptible. Putrid ulcers form, whereby the poor animal is made blind, or lame, or may lose part of the lips. Large sores appear on the side of the face, the under surface of the abdomen, the inside of the thighs. The ulceration may extend through the corium, and into the tissues under the skin. The ulcers sometimes produced in the parts where the papules have been confluent may discharge a vitiated fluid for many weeks.

When the eruption has completely established itself, the general symptoms become less severe, and if the attack is a mild one, the animal will then probably recover by degrees. There may, however, be a recurrence of fever in the suppurative stage, which is a very dangerous one; the patients lie chiefly on their sides and moan in agony, heave at the flanks, have their eye-lids, heads, and lips swollen, give forth a discharge of fetid mucus from the nostrils and of frothy saliva from the dry and hot mouth, the tenderness of the body being at the same time so marked that a simple touch will bring on convulsions. The pulse is quicker, the breath offensive, purulent material forms in the tissue under the skin, the alvine discharges also are copious, offensive, and uncontrollable; and death quickly ensues, very generally during the first week succeeding the eruption. If the animal should happen to recover, untoward results may happen before long, especially in the case of in-lamb ewes. The average direct loss is about 50 per cent.

In cases of recovery, the eight days succeeding the stage of

suppuration are occupied by the process of desquamation, which is delayed if suppuration has occurred. The crusts formed vary in colour from brownish yellow to black, and are thicker when thrown off from a pustule than from a vesicle. When the scabs fall off, pits of different sizes are left. Even in mild cases a month will generally elapse before health is restored.

If a flock is found to be attacked with this disease, the first thing to do is to separate the sheep which are infected from the healthy individuals. The former should be slaughtered at once and their carcases buried with antiseptic precautions, while the latter should be taken as far away as may be practicable. They should be put on dry grass land, or they may be supplied with turnips and mangold-wurzel in moderate amount, together with a little good cut hay, a small quantity of oats, and a little salt, unless rock-salt is placed in their troughs. A dose of opening medicine may be given, consisting of about two ounces of sulphate of magnesium, half a drachm of powdered aloes, half a drachm of ginger-root, and eight fluid ounces of tepid water. In the general way only a gentle aperient should be given.

Post-Mortem Changes in Cases of Sheep-Pox.—Examination after death showed that the skin was studded with papules, most of which were close together in large patches, a section showing that they extended beneath the skin, and looking like a section of a wart. The cellular tissue beneath the skin was infiltrated with blood, and purulent formations are often seen beneath the confluent papillæ; the mucous membranes, especially of the respiratory system, are chiefly affected, the conjunctival and Schneiderian membranes and the mucous lining of the trachea and bronchi were highly injected. The vessels of the lungs were engorged, whereby death was caused.

The skin may be red in one part and bluish black in another, and everywhere the wool is very easily separated. Serum may be present in the cellular tissue of the face and extremities. There may be signs of ulceration in the conjunctiva and cornea.

The pituitary membrane is often studded here and there with yellowish spots or nodules, which no doubt are structures similar to papules.

These are not confined to the nasal portion of the respiratory system, but also extend into the larynx, trachea, and bronchi. Occasionally small ulcers are seen on the epiglottis and other

parts of the larynx; but they rarely extend as far as the bronchi. The smaller air-tubes and cells are mostly full of dark mucus, but they are less marked and engorged with blood than other portions of the air passages. Generally, the lungs are congested, and irregular liver-coloured spots are seen under their pleural covering. As a rule, the intestines are free from disease, except in cases of severe diarrhœa. The kidneys may be softened and have spots similar to those seen on the lungs under their capsules. Simple congestion of the brain and spinal marrow, or of their coverings, may be observed.

Now, with regard to the operation of ovination, great care is requisite both as to the selection of the fluid and as to the mode of procedure. It is especially necessary that pure lymph should be chosen, and that deep punctures should not be made. Under Professor Simonds' management several scratches were made through the epidermis on the inner side of the fore-leg of a healthy sheep. On these slight incisions some transparent lymph which had dried was rubbed, and the limb was kept extended until the exuded blood had dried. On the next day the skin was inflamed and raised in the form of a fold, and on the following day the cuticle was raised owing to an effusion of fluid beneath it. On the next day pustules containing secretion were formed, which at first were yellow, but darker on the succeeding day, partly, perhaps, in consequence of a drying up of their contents. Two days afterwards, many of the scabs came off, and the exposed sores looked healthy. Five days after this, a slight inflammatory blush alone remained as a trace of the inoculation, the effects being for the most part local, the general health not suffering, notwithstanding that the corded state of the lymphatics proved that a general effect on the system had been produced.

Captain J. S. Carr, writing to *The Mark Lane Express*, under date October 12, 1847, recommended that all who should know that this frightful scourge is in their vicinity should have their sheep and lambs inoculated with virus taken from animals afflicted with the disease in a mild form. About seven years before 1847, the same writer had heard of the sheep-pox appearing in the neighbourhood of Lauenburg, and he consequently had his own sheep and lambs at once inoculated in the ear. The result was that he lost no more than 6 per cent. of lambs and 1 per cent. of sheep, and this same plan was equally successful

with many of his tenants. In another village on the same estate where no preventive measures were taken, not a single sheep was left. This observer maintained that immediate inoculation would not only generally save nine-tenths of sheep which were unaffected, but that it would also lighten the disorder in the case of those individuals of the flock which already showed signs of disease. The great objection to inoculation is that inoculated ovine-pox is quite as contagious as the natural disease itself; and, moreover, the deaths may be at the rate of 20 per cent.

Hence there is a great deal of danger in this operation, and it is obvious that the care taken in regard to the selection of the fluid and in the method of procedure cannot be too minute. Especially is it necessary that pure lymph should be selected, and deep punctures should on no account be made. Moreover, the operation ought not to be performed on lambs that are less than four and a half months old. The lymph should be taken from those sheep which have had the disease in its mildest form, and the operation should be performed at a time when the weather is genial and temperate, as may be the case late in spring or early in autumn.

The places usually selected are the under side of the flap of the ear, or the under surface of the tail, close to the root. A needle with a fine flat point, or a lancet dipped in the virus, should be carefully inserted between the upper and the second skin. Great care should be taken to avoid piercing so deeply as to draw blood, since large punctures are sure to be followed by extensive or deep and dangerous sloughing. In fact, the scratches cannot be too superficial. There should not be more than three punctures, and they should be about two inches apart, so as to prevent the probability of an extension of the inflammation from one to another. It is well to have one on either side of the abdomen and a third on the inner surface of the thigh. The virus, after being introduced, remains dormant for a few days. If the inoculation takes, a red speck appears around the incision, and increases until it is as large as half-a-crown, then depression of its centre occurs, together with constitutional disturbance of the animal, and perhaps an eruption. If no signs appear by the eighth day, the inoculation may be supposed to have failed. The vesicles produced by ovination will yield lymph about the eighteenth day. Some say that after the lymph has

been passed through twelve or fifteen sheep it loses its efficacy, but that at about the tenth remove a fluid is obtained which produces a mild and not dangerous malady. The lymph may be collected and stored in capillary tubes, afterwards hermetically sealed at the ends, or ivory points may be charged and allowed to dry. In time the lymph apparently becomes inert. The early-formed lymph taken from small vesicles is the most pure, transparent, and viscid. If, after restoration to health, the patients be again subjected to re-inoculation, or to the contagion itself, no ill affects arise, inoculation being as powerful a preventive as the natural disease itself. The animals should be kept quiet and carefully attended to in regard to diet, and they should be guarded against the vicissitudes of the weather, cold and draughts, and so forth, provided with well-ventilated quarters, well housed during the night, fed with good hay and coarse meal, some of which last should be mixed with their water. If the weather is mild and fine, the inoculated sheep may be allowed to graze on the pastures and be out, even at night; but when it is cold and damp, they should certainly be sheltered and supplied with nourishing diet. Should they be left out of doors in very severe weather, those sheep which have been most strongly affected will suffer greatly from local disturbances, great fever, and diarrhœa which will generally lead to death.

We have briefly described the process of ovination, as it was known in 1848.

Vaccination has generally produced upon sheep only a local and feeble action, very much less than that on the human body. It does not seem to affect the general system of sheep. It is of no use to try to prevent sheep-pox by vaccination. It is supposed that vaccination cannot be substituted for ovination. It has not been found possible to communicate human small-pox to the sheep. The conveyance of human small-pox to the ox is said to engender the true vaccine. Vaccine matter having failed in Egypt, it was found that by inoculating the cow with small-pox from the body, fine active vaccine virus is produced; but it really requires to be humanized before it can be depended upon. Whether the product of the natural ovine vesicle can be substituted for the vaccine is very doubtful. Some hold that the transmission of the ovine lymph to the ox tribe is the best means of rendering it more suited for the inoculation of sheep, and it

has also been averred that ovination of the subject is equal to vaccination as a prophylactic against small-pox. This, however, is very doubtful indeed. It appears that ovine variola cannot be transmitted by inoculation either to the cow or probably to man. The inflammation which has come on in the punctures of children has declined in a few days without being attended with any specific effects. Many children have been ovinated several times in succession, but without any successful result. The same children have afterwards been vaccinated, and at the usual time the vaccine disease has been developed and passed regularly through its course; while simultaneously the same kind of ovine virus has been inoculated on sheep, and the small-pox has been produced. Attempts to communicate variola ovina by inoculation to horses, oxen, goats, deer, pigs, dogs, monkeys, rabbits, and various birds are also said to have been unsuccessful.

Varicella has been said to occur in sheep; but the disease so spoken of has probably not as yet been sufficiently examined.

If sheep-pox should perchance break out again in England, the best course would probably be to slaughter all animals that were afflicted or had been in close contiguity with animals which were known to be afflicted. With regard to the practice of ovination, whereby the disease is imparted in a mild form to sheep liable to be attacked, the subject is one which does not really affect the sheep-farmer in England, and as it is an extensive one, we refrain from entering upon the consideration of it more fully.

DIPHTHERIA.

We wish to insert here the briefest possible allusion to a question we have often and often had occasion to discuss in the columns of *The Yorkshire Weekly Post*, and elsewhere, namely, to the relationship subsisting between certain diseases of mankind on the one hand and those of animals on the other. Every day this question is receiving more and more attention, and the communicability of some diseases of lower animals to man himself is established beyond all doubt. We find that *The Times* (a journal which is always well up to the foremost scientific work), in its issue of Thursday, August 4th, 1887, gives an account of Dr. George Turner's recent report on diphtheria. This observer has had experience of that disease considered

especially in its relations to lower animals partly obtained in the course of inspections made for the Local Government Board in 1886. The report is of such great importance to the community as to justify us in making the following abstract of it:—

Though much has been learned respecting conditions favouring its spread and fostering its virulence, still little or nothing is known of the beginnings of diphtheria. The earliest cases which occur in an epidemic of diphtheria are frequently very mild, and the first persons who die are almost invariably children who are generally supposed to have suffered from "croup," and indeed it may be that at the commencement of an outbreak diphtheria may be mainly a local disease, causing death rather by suffocation than by its general effects upon the system. The disease is propagated by personal communication, where circumstances are favourable, as by association of children in school. Slight cases, and even convalescing patients, may serve to cause very intense disease in other subjects. Thus, when a school has been closed owing to the existence of diphtheria among the scholars, the disease may recur again and again after the re-opening of the school. Children who are convalescent after an attack of diphtheria do not seem to do much harm in their own families, but as soon as a few of them congregate in school the disease is apt to reappear with great severity.

Over-crowding, badly-trapped drains, damp walls and floors, all tend to enhance the severity of diphtheria, as also does saturation of the soil under the dwelling with fecal matter or with water contaminated with excrement. Cases seem to occur, however, for which neither personal communication nor any of the above conditions can be traced, and the question arises:—"Is there no other possible source of diphtheria?" The communication of the diseases respectively known as anthrax and glanders from certain lower animals to man has long ago been established beyond any possibility of doubt. By the medium of cows' milk, scarlatina, diphtheria, and enteric fever have been transmitted to the human subject, and recently Dr. Klein has proved that a disease of the cow, which causes the animal little or no discomfort, can by the channel of the infected cow's milk reproduce itself in man as scarlet fever, one of the best-known and most fatal of infectious disorders. The cow disease in question is of a trivial nature.

In the year 1882 a pigeon was brought to Dr. Turner, who found the whole of the wind-pipe covered with a well-marked consistent membrane, hanging loosely in the tube like a wind-sail, just as one may see it in the body of a child who has died of croup. A person inoculated pigeons in the fauces with this membrane, and the result was that a similar disease occurred, and extended up into the eye of the pigeon through its nostrils.

In 1883 an epidemic of diphtheria broke out in the village of Braughing. The first cases were connected with a farm, whereat the fowls were dying of a disease apparently identical with this disease of the pigeons. Diphtheria made its appearance also on other farms, where it was also preceded by a similar affection among the fowls.

Dr. Turner noticed the same association in other instances, and during the summer of 1886, while he was making inquiries for the Local Government Board into an outbreak of epidemic diphtheria at Farnham, he found that the fowls had been affected at the same time as human beings at Aldershot, at which place a veterinary surgeon dissected some chickens, and noticed the presence of a membrane in the trachea. It had occurred, too, among turkeys and fowls at Ash, and also very prevalently at Long Eaton, in Derbyshire; while at Tongham, and near it, the disease had caused great havoc among chickens and pheasants. At Tongham a game-keeper clearly described the white crusts round the beaks, the patches in the throats, the affections of the eyes and nostrils, and the absence of strangles (*Sclerostoma syngamus*). As a matter of fact only the very young chickens usually succumb to the animal parasite, while numbers of the older birds die from this other disease now in question.

A man bought a chicken at a low price at an infected farm at Tongham, the bird being thought likely to die of this diphtheria-like disease. He took it home, and diphtheria itself broke out in his house shortly afterwards. This was the first case in that village. Dr. Turner mentions that he has also seen chickens and pigeons which had been inoculated with diphtheritic membrane from a child's throat, attacked as if with natural fowl-diphtheria. Similar accounts are received from abroad (vide *British Medical Journal*, October 6, 1884, also *Journal d'Hygiène*, 1884, p. 411). The same observer

had also noticed a disease in swine apparently exactly similar to human diphtheria, and had remarked that at Braughing both the swine and horses suffered from sore throat immediately after the epidemic among the human beings.

In January, 1886, having been called upon to investigate an epidemic of diphtheria at Brent Pelham (Herts), he found that in the cottage in which the first cases occurred a kitten had previously suffered from a throat affection, attended by swelling of the neck, foul discharge from the nostrils, and "running" at the eyes. Two cats had died at the general shop in the village, and the shop-keeper himself subsequently suffered. Similar disease existed among the cats at Aldershot, in Hants, at Farnham and Yateley, in Surrey, and at Petersfield, in Sussex. At Petersfield it was clear that a cat had been infected by diphtheritic children. Moreover the cats in a row of houses in which the disease had been prevalent were noticed to be ailing.

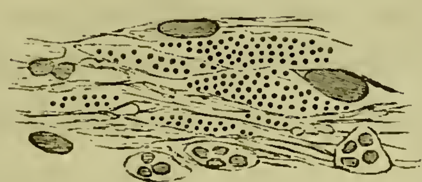


FIG. 39.—PORTION OF A DIPHTHERITIC MEMBRANE. Numerous Micrococci are seen to be present.

Their throats were swollen, and there was discharge from the eyes and nose.

At Moulton (Suffolk) some children were ill of diphtheria in a cottage at some distance from the village. They were confined to the upper rooms of their cottage, and no food which had been offered to the sick children was set before the others. It was given to the cat. This animal subsequently suffered very severely, but eventually recovered.

In the *British Medical Journal* of January 3, 1885, there is an account of some experiments by Dr. C. J. Renshaw, who seems to have succeeded in inoculating cats with diphtheria by means of diphtheria material of man.

At Moulton, the first case of diphtheria at a farmhouse occurred shortly after a horse on the farm had died of strangles, while the second was that of a stable attendant. In the neighbouring village of Ouseden, a man who had recently recovered

from diphtheria was for a short time employed to groom a mare, which animal in a few days was affected with "strangles," shown by much swelling at the angle of the jaws, and a very foul discharge from the nose. At Yateley, diphtheria in the human subject was in two instances coincident with strangles among the horses.

Dr. Ogle relates that he met with a case in which diphtheria broke out in a shepherd's family shortly after a throat disease had prevailed among the sheep.

There seems at least to be sufficient evidence to encourage careful inquiry as to connection betwixt diphtheria in man and certain affections in animals. It is said that in the Australian bush diphtheria sometimes appears under circumstances which almost preclude any conveyance of infection by human beings or by prevailing winds. [We may here add that the same has been said of the occurrence of typhoid fever in isolated localities in South Africa and elsewhere.]

We proceed to speak now of diphtheria in the ox. In doing so, we cannot but feel regret that what appears to be known at present regarding this matter is very incomplete, and short of imparting satisfaction. Once again we may reiterate that these questions as to the connections between allied diseases in different classes of animals deserve the most careful and the most thorough and painstaking investigation, as indeed they are now receiving at the hands of able scientists. Years and years of prolonged research will be necessary before we shall be able to say that we are really beginning to comprehend the workings of disease, and no one should lose an opportunity of arousing some of that enthusiasm among workers in the field of science, which must be acquired in order to carry them through the immense amount of labour which is necessary in order to solve these weighty and most momentous problems.

It was, we believe, in the year 1880, that Mr. W. Beach, to whom great credit is therefore due, brought forward the belief that the disease known by the name of diphtheria as affecting human beings, also invades cattle. He suggested, and seemed to believe, that the disease which he considered to be diphtheria in oxen originated from the disease of the human subject known by that name. The symptoms seem to be somewhat as follows:—The pulse is quick, the throat is sore and swollen, and

consequently difficulty in swallowing is apparent; the animal has paroxysms of coughing; there is a discharge of mucus from the nostrils, and a flow of saliva from the mouth; the breathing is accelerated, during inspiration a crowing sound is produced; there may be spasms of the larynx, especially if the animal is excited, and, finally, great debility supervenes. The pulse becomes weaker and weaker as the disease progresses, and the coughing assumes a more violent character. At about the third day after the commencement of the malady, lymph-casts of portions of the air-tubes, or, at any rate, flakes of lymph, are thrown up.

If death closes the scene, and an examination be made (great care being taken to avoid inoculation), the air tubes and the tonsils may be seen to be lined on their inner surface with a greyish membrane, which, in case the animal has died at an early stage of the disease, is firmly attached to the tissues below, while if the case is one of some standing, this membrane is observed to have been loosened owing to the process of effusion or suppuration which has gone on beneath it. More than all this, the alimentary canal, the eyes, the tissues under the skin, the digits, the pasterns, and the hoofs, the membranes lining the interior of the genito-urinary passages, may all respectively, or, indeed, more or less collectively, be invaded with deposits of the characteristic exudation. According to Dr. Fleming, even the horns may be shed.

Various writers have described a disease which is no doubt the same. For instance, in *The Veterinarian* of December, 1880, there is a translation of a paper written by M. Lenglen, of Arras, who therein describes a disease in which the lining membrane of the mouth sloughs away in patches of great size near the molar teeth or on the tongue, there being also a tendency to the formation of an abscess in the cheek or lips. The animal, generally a young calf, but one which may be several months old, suffers also from a fetid diarrhœa, which often brings on a fatal issue.

Another observer, Dammann by name, finds that this disorder is general as well as local, that it affects the air-passages as well as the mouth, also the intestines, lungs, and the clefts between the digits. The symptoms are fever, prostration, salivation, swelling of the cheeks, stiffness, sore throat; and there are

microbes in the form of bright granules and rods in the deposits. The disease seems to be communicable to other calves and to mankind. Numerous bacilli occupy the line of junction between the diseased and the healthy tissues. These bacilli are capable of propagating the disease. Pigs and other domesticated animals are liable to be attacked. The best treatment is very careful nursing coupled with liquid food, steaming of the air-passages with an antiseptic inhalation such as can be made by adding about a teaspoonful of oil of eucalyptus to about a gallon of boiling water, a free supply of water with chlorate of potassium added to it (about a drachm to each half-bucketful), and a plentiful supply of air. Salicylic acid has been found valuable as a curative agent. The dose is about one drachm. Sulphite of sodium is of great, and perhaps of inestimable, value. It may be administered in doses of one drachm, given rather frequently, in accordance with the requirements of the particular case. If there is danger of suffocation, the veterinary surgeon must perform tracheotomy.

In the management of this disease a nourishing administration of vegetable tonics, and of coffee according to some, are to be recommended. The sloughs in the mouth should be removed, and the places left bare should be acted upon with the tincture or the solution of perchloride of iron (Mr. James), or with some caustic, or perhaps with weak solution of perchloride of mercury carefully applied.

SCARLET FEVER OR SCARLATINA.

If it is true that a rose with any other name would smell as sweet, it is equally obvious that immense importance attaches itself to correct nomenclature. Hence, in assigning to any disease of the ox emphatically and categorically the title of scarlet fever, one might, in the present state of knowledge upon the subject, be considered to be a little bold. The kind reader who has followed us in our efforts to clear up some of the difficulties connected with the most important and interesting, though difficult and intricate, science of pathology, will clearly realise how considerable is the amount of cautious judgment which is necessary before we apply to two diseases, occurring respectively in two different kinds of animals, the same designation.

If it is not always an easy matter to diagnose a disease in any individual man or animal, owing to notable differences which very frequently present themselves, it is doubly difficult to decide whether or not there is sufficient justification in any particular case for applying to a malady exhibited in one kind of animal the same name as that which is used to denominate a disease in another kind of animal. Of course there are not a few cases in which we use the same appellation without any hesitation. For instance, both in the matter of its origin and in that of its characteristics, rabies is a disease which varies but little in different animals. There are many instances, however, in which it is a matter of no small debate how far the resemblances which do exist justify the use of the same name; for though the similarities may be great, the diseases may nevertheless be altogether and essentially different.

Though, then, we should in pathology, as in all other studies, be on our guard against a tendency to remark dissimilarities rather than resemblances, we must also avoid laying too much stress on similarities found among things which are in reality distinct. Such a mistake was made in the case of measles and scarlet fever, and as a matter of fact down to about the middle of the sixteenth century these two diseases as occurring in mankind were not considered to be different maladies. It was only after closer inspection that their distinguishing characteristics were remarked. Again, at the present time it is difficult to decide how far swine fever is allied with typhoid fever of man, though it is probable that the two are very intimately allied. Further, if we turn to scarlet fever of man, and inquire if there is any disease of the ox closely corresponding with it, we are confronted with an arduous point of dispute.

In the attempts we shall make to throw light upon this most important point—important because it so intimately affects the human race—we shall in the first place make a few observations regarding this fever as it presents itself in man. We shall then discuss briefly the characters of the bovine diseases known as erythema mammillarum and as scarlatina respectively. In passing we may now remark that these are probably the same disease as that which has recently been described by Power, Cameron, and Klein, and at the same time that the former is possibly simply a state occurring sometimes more and sometimes less

markedly as one of the symptoms of scarlatina itself. In other words erythema mammillarum is possibly but a local manifestation of the general fever.

We shall then proceed to mention some points elicited in the investigation of Power, Cameron, and Klein, and treat shortly of the malady they have described as having occurred in certain cows, and as having given rise, by vitiating the milk, to scarlatina in the human subject. Accepting the conclusions drawn by these observers, and in consideration of the fact of a pronounced resemblance in the character of the changes which take place in both diseases, we may consider that this Hendon cow disease to which we refer is nothing else than bovine scarlatina, the same malady which veterinarians had previously, but by no means accurately, described.

Scarlet Fever in Man.

And now, in continuation of our subject, we propose to give a general account of Scarlet Fever as it appears in man, after which we shall give an abstract of the investigations recently conducted at the instance of the Medical Officer of the Local Government Board by Mr. Power in co-operation with Drs. Klein and Cameron, mentioning and briefly discussing some of the very important points elicited by the classical researches of these able investigators.

Scarlet fever, then, may be spoken of as an infectious disease, which is chiefly characterised by the appearance of a general punctiform eruption, which generally manifests itself on the second day, and by inflammation of the fauces, tonsils, and kidneys.

Dr. Gee defines scarlet fever as an acute pyretic disease, specific both in its cause and in its course, and producing in its course an exanthem with characters quite peculiar.

In regard to its history, it appears that down to about the middle of the sixteenth century this fever and the disease known under the name of measles were not considered to be distinct and different maladies. It was only after a closer examination of them that their distinguishing characteristics were observed.

The earliest record which we have of the existence of scarlet fever is that which bears the date A.D. 1556, the year in which

Ph. Ingrassias published a description of a malady which had been previously recognized by the common people, and named by them Rossalia. It is possible that examples of a severer type of the same disease formed part of the notable epidemic of malignant angina which raged sixty years later in the South of Europe. In Germany, about this time, Sennertus noticed what he supposed was the rossalia of the Italians, and what no doubt was our scarlet fever. In 1676 appeared Sydenham's *Febris Scarlatina,* and by the end of the same century the disease had been described in all parts of civilized Europe (Noirot). Scarlet fever is the same disease as that called "morbilli confluentes" (Morton), and as the "febris rubra" of Heberden.

At the present day the fever is generally met with among human beings throughout the world, but it has at least in England its peculiar seasons of prevalence. The ravages of this malady are promoted by poverty, by overcrowding, and by other mal-hygienic conditions, and so infectious and widespread is the virus of the disease among mankind that very many children are affected with it during the first few years of life, and are thereby in a great measure protected against future attacks. Hence arises the fact that scarlet fever seems to occur more frequently in children than in adults. The disease, however, although it rarely occurs a second time, in like manner with small-pox, may recur as many as three times or possibly even more frequently; but, as is to be expected, the disease under such circumstances has by no means the same power for mischief as it has in the case of a first attack. It frequently happens, too, that persons attending on patients affected with scarlatina suffer from sore throat, and there is evidence to show that this sore throat may in reality be a sign of a very mild or abortive attack.

It is most probable that scarlet fever has its origin in the presence and multiplication of a definite germ; for very minute micrococci have been found in the blood of scarlet fever patients, also in the ulcerations and discharges of the throat, and in the scales of skin which peel off in the later stage of the disease, when the process called desquamation is going on. These scales, then, may in all probability be looked upon as fertile sources of communication. The micrococci are found in small groups, and they have a diameter of about ·0005 mm. To this point

we shall again recur. The virus of scarlet fever is of a powerfully infectious nature, and it may be conveyed from an infected person to others by the medium of the clothes, the furniture, and so forth, and it is to be borne in mind that the infective properties persist for a long time. Apparently the virus may be carried great distances by the medium of the air—at any rate, through the dimensions of a large ward, and also doubtless even from the hospital to the neighbourhood which immediately surrounds it. It clings to clothes with great tenacity, and may thus lie latent for an indefinite period, and it is liable to infect milk and other articles of food. The fever may be transmitted by infection or by direct inoculation. Women at the time of parturition are very liable to take the infection, possibly receiving it, it has been suggested, directly from the fingers of the accoucheur in some instances. The infectiousness of the fever is greatest when the rash and the sore throat are developed, and it certainly does not cease until desquamation has been completed.

The period of incubation in the case of scarlet fever is shorter than that of most diseases of the same class. It usually varies from six to eight days; but it is sometimes longer, and very frequently less, and may be as little as twenty-four hours. It is especially in the case of puerperal women, and probably also in that of persons suffering from large wounds, that the latent period seems to be of very short duration. The fever varies wonderfully in regard to the degree of its severity, in the symptoms; and, when death occurs, in the cause which finally brings it on, and the time at which the fatal result ensues. The onset of the disease is sudden, the first noticeable signs being chills, *sore throat*, *vomiting*, dryness of skin, drowsiness, headache in the region of the forehead, giddiness, aching of the limbs, coating of the tongue, thirst, loss of appetite, and sometimes also diarrhœa. The pulse at first is very rapid.

There is reason to believe that the irritation of the throat is in some measure a cause of the vomiting which occurs at an early stage in cases of scarlet fever, and since vomiting also occurs at the onset of diphtheria and small-pox, in which the fauces are attacked, and also closely follows the onset of inflammation of the fauces, it seems as if in all those cases the irritation is at least in part a cause of the vomiting. (Dr. D. Astley Gresswell.)

The pulse may be about 120 in the case of an adult, about 160 in that of a child, and the temperature may be nearly 105° F. during the first day. The patient may be delirious, or may even exhibit a tendency to coma.

On the second day the rash may make its appearance on the chest, fore-arms, lower part of the abdomen, and upper part of the thighs, and at about the middle of the third day it reaches its greatest intensity. At first it consists of very minute rosy spots or papules which may possibly be due to the conical elevation of the cutis around the points wherefrom the individual hairs emerge. These spots afterwards enlarge and become more red, and they may blend in some degree so as to impart to the skin a uniform scarlet hue, although if the skin be closely inspected the papular character of the rash can still be observed. The spots situated on the chest and neck may not unfrequently become vesicular. The rash is usually attended with more or less infiltration and thickening of the cutis. It may be the case, though very rarely, and either when the rash is at its height, or at the beginning of its decline, that a serous fluid is extensively poured out beneath the epidermis, especially that of the trunk, so that the surface becomes covered with small flat blebs which tend to become continuous. This condition necessarily leads to a larger and coarser desquamation than usually occurs. If the skin be pressed, as, for example, by drawing the edge of the nail firmly over it, the vivid redness of the skin disappears for a second or two. The rash varies greatly both in regard to its intensity and to its diffusion, and it may be limited to the parts in which it first appears. The rash is often especially marked on the neck, chest, abdomen, and inner aspects of the thighs and arms. The feet and hands may not uncommonly be stiff with it, and the œdema which attends it.

The rashes of the specific fevers sometimes illustrate the similar origin of the parts which they affect. For instance, the rash of the fever we are now considering, namely, scarlet fever, may occur in many parts of the body which have been developed from the epiblast. It may occur on any part of the skin, and is only rarely distinctly marked on the face, although there are frequently irregular patches of redness on it. However, the rash may be only seen on the face with some difficulty,

owing to the two facts, firstly, that the skin of the face is naturally full of blood, and, secondly, that the scarlatina rash is much more uniform than most rashes are, and is consequently not so easily observed. The rash occurs also on the scalp, on the oral and faucial mucous membranes, probably also on the nasal mucous membrane, as is shown by the constant thick stream of discharge so frequently seen flowing from both nostrils in infants and children, also on the conjunctiva, in the external auditory meatus of the ear; probably also in the middle ear and eustachian tube. These latter points lead us to the recollection that the mucous membranes of the fauces, eustachian tube, middle ear and external ear are originally derived from the lining of one cleft, the tympano-eustachian, the representative of the permanently open spiracle of the Selachii. Observations of a similar nature are to be made in regard to the two diseases, measles and small-pox.

While the rash is attaining its full development, the other symptoms are all becoming intensified. The temperature rises, and the pulse and respirations become more rapid. The tongue, which at first was covered, with the exception of the tip and edges, with a thickish whitey-brown fur, becomes more thickly coated. At a later time the coating falls off, and the tongue becomes in about four and a half days from the outset of the malady red, clean, and moist, with swollen papillæ, and shows that remarkable strawberry-like appearance which is so characteristic of this disease. In severer cases the tongue quickly becomes dry. The soreness of the throat increases, and a more or less vivid or dusky redness and swelling of the pillars of the fauces, soft palate, uvula, and tonsils, are apparent. The tonsils generally enlarge, and here and there on their surface specks of inspissated secretion may be seen. With the faucial swelling and inflammation, there are generally associated pain and difficulty in swallowing, fulness and tenderness behind the angles of the jaw, and some enlargement of the lymphatic glands of this part. There is much weakness, the limbs may be tremulous, and the patient may become delirious and look dull and stupid or restless, and be persistently so until death supervenes. The vomiting generally subsides at quite an early time; but in malignant cases it is severe, and may be almost continuous. The bowels are variable in regard to their action,

but are generally confined. In considering the symptoms of scarlet-fever in man one should not forget to bear in mind that the very mildest cases may almost be said to be without symptoms.

From the fourth to the sixth day of the disease the rash begins to fade, and it disappears between the sixth and the twelfth day of the disease, or between the fifth and tenth day from the appearance of the rash. From about the fourth to the sixth day it frequently happens that the patient, if progressing unfavourably, passes into a typhoid condition, or serious throat complications may ensue. The tonsils may ulcerate from almost the outset of the disease, or slough, or perhaps the urine may become albuminous. It seems to be quite exceptional for dropsy or uræmia to occur at this time. On the other hand, if the case be going on favourably, all the symptoms at about this time gradually subside. The temperature, with slight daily remissions, ere long becomes normal, or even below the normal standard. The pulse, too, rapidly sinks to its healthy rate or slightly below it, the soreness of the throat subsides, the tongue becomes clean and moist, the thirst abates, and the desire for food is regained.

Desquamation commences when the rash is fading. It begins, as a rule, on the neck and chest, whence it spreads to the rest of the trunk and limbs. The desquamating epidermis may be in the form of a fine powder, or it may be in flakes of very variable size. That from the hands and feet may indeed be in the form of a glove. The size of the flakes when they are shed from parts whereon the epidermis is thick, is larger in proportion to the thickness. Hence the flakes are small and delicate on the chest and abdomen, but large on the limbs. Sometimes a transverse fissure at the root of the nails shows that desquamation is also indicated in the nails, or that the growth of the nail has been interrupted. The period of desquamation varies in duration from a few days to several weeks. It almost always occupies at least two weeks, and generally from four to eight weeks. It is to be remembered that it is chiefly during this period that albuminuria with dropsy and uræmia may supervene. It may also be observed that rheumatism is liable to come on shortly after desquamation has commenced. Moreover, there is good reason to believe that the particles of skin which are thrown off in desquamation are highly infectious.

Acceleration of the pulse, especially in children, is a notable feature of the disease. On the first day it probably rises to between 100 and 120, and in children still higher. It generally continues to increase up to the time of full development of the rash, sometimes attaining a rate of 160 or more, after which, if the case go on favourably, it somewhat rapidly falls. Unusual rapidity of pulse, together with marked weakness, is of grave import.

Respiration is always at first more or less hurried, *i.e.* in all but the mildest cases; but there is not necessarily any cough or difficulty of breathing. If the case is a very bad one, the respirations become very rapid and shallow, and the inspirations are attended with dilatation of the nostrils, and a sniffing or sucking sound. These conditions, unattended with distinct pulmonary lesion, indicate very great danger. During the latter part of the eruptive stage or subsequent periods of the disease, inflammation may extend to the larynx and trachea, and produce the usual symptoms of laryngitis; or coryza, bronchitis, or lobular or lobar pneumonia, with their several groups of symptoms, may come on. Coryza may occur at a very early stage.

Thirst and loss of appetite are always present in a greater or less degree during the pyrexial state. Vomiting is a characteristic feature of the invasion, and there are but few children who do not suffer from it; but it does not persist as a rule. At the beginning diarrhœa may occur, and afterwards the bowels are generally, but by no means always constipated. The tongue varies in character. In very mild cases it is only slightly furred, and soon cleans, without ever displaying the strawberry-like appearance. Sometimes it very early becomes thickly coated, dry, and even black, sordes appearing at the same time on the teeth and lips. More usually it is coated at the first, and on the fourth or fifth day it becomes clean and unnaturally red with prominent and swollen papillæ, after which it may either gradually acquire the normal characters or become dry and mahogany-like. The soreness of the throat causes difficulty and pain in swallowing, and a nasal quality of voice. The soreness involves all the parts at the back of the mouth, the fauces, and the upper part of the pharynx; but it does not, as a rule, include the larynx. The tonsils chiefly suffer, and, as has been

pointed out, they generally become enlarged and present on the surface opaque patches which have been secreted by the glandular follicles. In mild cases the soreness may be very slight and speedily subside. Very often, however, sometimes at the beginning, but more frequently in the second or third week, the tonsils suppurate, ulcerate, or slough, or buboes and abscesses form near them, or a false membrane appears on the surface and extends to other neighbouring parts.

During the febrile stage of the disease, the urine is scanty and high coloured, contains a diminished quantity of chlorine, and, according to Dr. Gee, not necessarily any increase of urea. Subsequently it becomes more abundant and of lower specific gravity. Albumen is often present in the urine, and its presence is important. Many of the cases very severe in onset escape albuminuria, while many of the mildest suffer severely. Albumen has been detected on the second or third day of the disease, but more commonly in the course of the second or third week, during the period of desquamation. The amount of it varies, as also does the time during which it persists. Not unfrequently the urine is smoky, and when it is examined by the microscope, hyaline and epithelial casts of the renal tubules are found, and usually also blood-corpuscles, or casts containing altered blood.

During the height of the disease, the skin is generally dry and feels hot, and in malignant cases "petechiæ" often appear. The temperature of the body attains a marked elevation very early in scarlet fever. It often reaches 104 deg. or 105 deg. when the eruption is fully developed, and very occasionally it rises to even 110 deg. or 112 deg. It is unlike small-pox in that the temperature rises instead of falling when the rash appears, and unlike measles in that it subsides slowly after the rash has reached its acme, instead of undergoing a sudden fall.

The patient complains of soreness of throat, and has some headache and giddiness, and general aching of the limbs; but the pains are not so severe as in many other febrile disorders. In the beginning of the disease the patient is usually restless and sleepless, and often a little delirious. When the eruption comes out, and during the time of its persistence, the patient may still be restless and excited, or dull and somewhat inclined to coma or delirium. If the fever is of a very grave kind, violent delirium may be one of the earliest symptoms. In children convulsions

may come on early in the disease; but they are rarer than at the beginning of measles or small-pox.

There is no disease which varies more than scarlet fever does. On the one hand, it may be one of the very mildest; or on the other, one of the most terrible, of diseases. Sometimes patients scarcely know that they have been ill, while at other times it may happen that not one of a household in which the fever breaks out lives through it. Indeed, the malady may be of so deadly a nature that a patient stricken down with it may die within the first three days, or even, it is said, during the very first day of attack, before the rash has appeared or the throat has become at all markedly sore. Again, while some epidemics of scarlet fever scatter death far and wide, others are of such a mild character that scarcely a single death results. Frequently the fever spreads rapidly through a village or town or over a large extent of country in so mild a form that hardly any fatal cases occur, while at other times an epidemic may be characterised by great malignancy, and a terrible mortality may ensue from its ravages. Some mild cases may be spoken of as examples of *latent scarlet fever*, and some would scarcely be recognised as scarlet fever at all but for the facts that they occur while that fever is prevalent, or that they impart scarlet fever, or that desquamation, with or without albuminuria, supervenes. Further, of cases of medium intensity, some may show severe sore throat and but a mild eruption, while in others there may be but little affection of the throat.

Another variety of scarlet fever is that in which the throat affection may be serious from the first; but more frequently it undergoes aggravation either at the height of the fever or during the subsidence of the rash, or even after its disappearance. There may, perhaps, be abscess of the tonsil, or marked ulceration, or gangrene, with œdema of the surrounding tissues, and, supervening thereon, the glands in the neck may inflame and suppurate, and sinuses may form. If so, the patient may fall into a typhoid condition and die, or may be carried off by œdema of the glottis, perforation of an artery, or pyæmia. Scarlet fever occurring at or just after parturition is said to be very fatal, and is regarded by some as a grave form of "puerperal fever." However, it does not appear to be especially dangerous during pregnancy or to lead to abortion.

In the course of scarlet fever, the conjunctivæ not unfrequently inflame, and occasionally in the second or third week of the disease, the ophthalmia becomes intense and purulent, and sloughing of the corneæ may result. Again, inflammation sometimes extends along the eustachian tube to the tympanic cavity, producing otitis, with possibly disease of the petrous bone, and, meningitis, abscess of the brain, or pyæmia. Inflammation may extend also to the nose and produce chronic catarrh of its mucous surface. Inflammation of the pericardium or of the pleuræ (the latter often purulent) is not uncommon. During the decline of the fever, or even during the period of convalescence, rheumatism may come on. To scarlatinal rheumatism, which, it is said, differs in no respect from ordinary rheumatism, affections of the heart, and chorea or embolism occasionally succeed. The most important complication, however, is nephritis, which frequently comes on in the second or third week. As a rule, this condition passes off without any ill result. Not unfrequently, however, uræmia comes on, attended with severe headache and convulsions, frequently ending in death. If judicious treatment be resorted to, the albuminuria and the dropsy may subside ; but at times the urine remains permanently albuminous, and the kidneys undergo slow disorganization. Anasarca sometimes remains after the disappearance of the albuminuria, and it is said that this condition occasionally arises in those patients who have never had albumen in the urine.

Morbid Anatomy.—In malignant cases there may be collapse and hypostatic congestion of the lungs, and hæmorrhage into and at the free surfaces of internal organs. The throat generally presents distinct traces of inflammation and ulceration. The solitary intestinal glands and Peyer's patches are somewhat enlarged, and may be ulcerated. Ante-mortem clots are not uncommon in the right ventricle.

Dr. Klein has shown that even at the earliest stage of the disease there is a marked tendency to inflammatory hyperæmia and proliferation, not only in the skin, mouth, throat, and kidneys, but throughout the alimentary canal, and in the salivary glands, pancreas, liver, lymphatic glands, and spleen. Generally in all these parts there are observed germination of the endothelium of the small blood-vessels, hyaline thickening of the intima, germination of the nuclei in the muscular coat

and accumulation of lymphoid cells in the surrounding tissues, besides which in the epidermis swelling and proliferation of the cells of the rete mucosum with serous effusion and migration of leucocytes between them, and tendency to detachment of the horny layer; in the various epithelia (including those of the renal tubules) changes resembling those in the skin; and in the interior of lymphatic glands, especially those of the neck, disappearance of the lymphoid cells, and development in their stead of many-nucleated giant-cells, which at last become fibrous.

In regard to the treatment of patients suffering from scarlatina, a great deal of judgment is always requisite. The remedies which have been employed are very numerous. As we have said above, scarlet fever varies very considerably in its intensity. On the one hand, if no complications occur, the malady may terminate favourably within about a week or a little more from its commencement. On the other hand, it must be borne in mind (as Dr. Gee points out) that however favourable may be the progress of a scarlatinal patient, confinement to bed should be insisted upon for a period of three weeks from the outset of the disease. Then the patient may be allowed to get up, but not to leave the room for another week. Even after four weeks have elapsed, the patient cannot be said to be free from all danger of albuminuria. Especially, of course, if the disease is of a malignant type, and also if any unfavourable pre-existing condition such as the puerperal state is present, must the greatest care be exercised.

The patient should at once be isolated, placed in a suitable room on the top floor of the house, which should be set apart exclusively for the patient. The usual measures should be taken in regard to nursing, ventilation, disinfection, cleanliness, and removal of surplus furniture. Carpets and porous materials should be removed. The bedroom should be well ventilated, in part by an open fire. The whole surface of the body should be sponged with tepid water in which a little of the salt, permanganate of potassium, has been dissolved, once or twice a day. The skin may be subsequently greased with mutton suet. The diet should consist of milk, beef-tea, eggs (one or two daily), light puddings, and farinaceous diet. Drink should be freely supplied. It should be remembered that purgation is to be

avoided. The salt, acetate of ammonium, or the nitrate or the chlorate of potassium may be administered in suitable doses in solution. In itself delirium is not necessarily a sign of very grave danger; but when delirium is continued, and when it is accompanied by severe vomiting and diarrhœa there is much need for apprehension. If the patient is low, the pulse quick, soft, and feeble, and if coryza be present, wine should be given, together with full doses of carbonate of ammonium in milk every four hours. Some recommend ammonia in large doses frequently administered, some advise the administration of diluted hydrochloric acid, or the perchloride of iron. Ice is often given to allay vomiting. In order to relieve the soreness of the throat, ice or the inhalation of steam or warm milk, slowly swallowed,* or astringent or antiseptic gargles may be used.

If the throat is much inflamed, the patient should be allowed to dissolve lumps of ice in the mouth. Ice can be given to patients above five or six years of age. Another plan of treatment in case of inflamed throat is the inhalation of steam. Puffy swelling of the neck may in some cases be removed by external applications of spongiopiline wrung out from hot water, or of hot linseed meal poultices frequently renewed. If coryza is manifested, it should be treated as soon as possible. An ounce of salt may be dissolved in a pint of warm water, and this solution contained in a vessel, raised a little above the head of the patient, is conveyed by means of a flexible caoutchouc tube into one nostril, respiration being carried on through the mouth, and all attempts at swallowing being forbidden. The fluid passes out freely by the other nostril. In young children the nasal fossæ may be syringed with a weak solution of nitrate of silver (gr. v. to oz. i.) once a day when the coryza is troublesome. If there is much constipation, the bowels should be relieved by laxatives ; while, if there be diarrhœa, opium or some astringents may be given. Some authors advise that the body be kept well greased during convalescence, in order to prevent the dissemination of the flakes of the cuticle; but others recommend that it should not be used, on the grounds that it stops the pores of the sweat-glands and so helps to cause nephritis. Warm baths may be employed

* It is, however, very difficult for a person suffering from sore throat to swallow slowly.

daily. Tonics must be administered. For at least the first three weeks the diet should consist in chief part of milk, and after that time it is generally recommended that the diet should be good, and include a fair amount of solid food. It is during the period of desquamation that the dangers of rheumatism and of dropsy are greatest. However, in ninety-nine cases out of a hundred rheumatism is an extremely mild affection when occurring in the course of scarlatina. In order to guard against chilling and increased liability to nephritis, the patient should be kept quite warm, and free from exposure to draughts, and he should be confined to bed and clothed in flannel for at least the first three weeks, and the excretory functions should be carefully attended to until the period of desquamation has come to an end.

In malignant cases and in those in which the muscular debility is great, and there is a tendency to collapse or to the appearance of typhoid symptoms, stimulants are imperatively necessary. Ammonia and brandy are nearly always needed in the malignant cases. Strong tea or coffee, brandy, ether, camphor, are to be given internally. Quinine is useful in cases of prolonged adynamia, and a very nutritious diet and a rather liberal allowance of wine will often enable such patients to recover. If there be nasal catarrh with discharge, it is advisable to syringe the nostrils with warm water, or weak solution of chlorate of potassium, nitrate of silver, or some antiseptic. If the throat be ulcerated or gangrenous, solution of perchloride of iron or of nitrate of silver, or hydrochloric acid or nitric acid may be applied, the utmost care being used.

Warm fomentations or poultices should be employed externally, and if there be suppuration in the glands or connective tissue behind and below the jaw, a puncture or incision may be made, if an actual abscess has formed. In fact, as soon as suppuration has occurred, some advise that an incision should be made to let out the pus, the poultices being afterwards removed. Sometimes openings and counter-openings will be required. If hæmorrhage should occur, the wound is to be stopped with lint soaked in the solution of perchloride of iron. If on the morning of the fifth or sixth day any ulcerous appearance that the fauces may have previously presented does not show signs of yielding, it is well to cauterise the morbid

surface. For the tonsils, undiluted hydrochloric acid is to be used; but for any other part of the soft palate solid nitrate of silver. This latter caustic is to be applied to those excoriations which may appear about this time. These potent escharotics cannot be used again, until at least four or five days have elapsed. The external swelling should be assiduously fomented, and poultices may be continued.

All cases of otorrhœa are to be treated by syringing the meatus gently with warm water three or four times a day. Should a discharge either from the ear or from the nose become chronic, quinine and sulphuric acid may be tried. If there is a suppurative tendency, quinine will also be found useful; also substantial food will be required.

As a rule rheumatism, if it be present, rapidly subsides under the influence of salicylate of sodium. Aperients, if necessary, may be administered, and cotton-wool or poultices may be put round the affected joints.

At the onset of renal dropsy, purgatives must be given; for instance, a good jalap powder in doses of not less than a scruple to a child of six or eight years of age, repeated at intervals of eight hours, until the bowels act freely.

The hot-air bath, preceded by a hot-water bath and a dose of antimonial wine, may be used every night, so long as the quantity of urine is much diminished. Vomiting may be in some degree checked by ice swallowed in small lumps. When there is much hæmaturia, gallic acid may be tried. Quinine does good in some cases, and perchloride of iron is useful in later stages. Counter-irritation to the loins will be useful, and a milk diet is essential.

When extensive anasarca is present, and especially if the dropsy tends to the lungs and pleural sacs, the danger is very grave indeed. Laxatives and diuretics should be continued, so long as the anasarca remains simple.

Complications must be treated in much the same manner as if they occurred in the general way, but it should be remembered that patients bear depletion less and need stimulation more. To these general lines of treatment we may add, as another point of very great importance, that those who are convalescing from attacks of scarlet fever may often be very greatly benefited by a change of air. It is especially the won-

derful value of sea-air that we would most urgently insist upon. Recently Dr. Albert Gresswell attended a little boy of eight years of age who had a rather sharp attack of scarlet fever. He progressed very favourably under his care, without any untoward symptoms arising. So soon as he was quite strong enough to be moved, and able to stand the change, he was, in accordance with instructions, sent to the seaside, every precaution being taken against any chance of catching cold, and so forth. The beneficial results which followed were very gratifying, and it was not long before he was quite restored to health and vigour. This is one case out of very many, and Dr. Gresswell speaks strongly in favour of residence at the seaside in the convalescent stages of scarlet fever.

Having given a short general account of scarlet-fever, we now proceed to consider the recently made discoveries in relation to the etiology of scarlet fever, the far-reaching importance of which cannot well be over-estimated. In the first place, then, we may say that concurrent outbreaks of scarlet fever were observed in the months of November and December 1885 in Marylebone, St. Pancras, Hampstead, St. John's Wood, and Hendon, among persons who had received their milk from a dairy situated at Hendon. An investigation was accordingly made by Mr. Power, with the result that the suspected dairy was found to be in a good hygienic condition. Moreover, it was elicited that no scarlet fever was prevalent, or had occurred for a long time in the neighbourhood of the dairy. Furthermore, the fever had broken out soon after the introduction into the dairy-farm of three newly purchased cows, and one of these cows was found to have small vesicles and ulcers on the udder and teats. This affection did not interfere with the yield of milk, and though it was not attended with any marked obvious signs of illness, it nevertheless spread rapidly among the cows which occupied certain sheds whence the suspected milk was derived. Moreover, some milk which had been condemned and was to have been thrown away was given to certain poor persons living near, and the result was that a severe outbreak of scarlet fever occurred among their children after a week had elapsed, and, we believe, especially among such persons as had derived their milk from the shed wherein the affected cows were kept. Two of the affected .cows were then purchased and handed

over to Dr. Klein for purposes of research at the Brown Institution.

Dr. Klein proved that micro-organisms existed in the fluid of the vesicles, and that these micrococci could be readily cultivated and grew abundantly in milk; that the disease imparted by the inoculation of calves with the virus presents symptoms very like those exhibited by the cow from which these micrococci were taken, symptoms, moreover, very similar to those of human scarlatina, and accompanied by similar pathological changes in the kidneys and other internal organs. He, moreover, also found that these micro-organisms were, in all essential respects, similar to those which he obtained from the blood of human beings affected with scarlatina.

With this short *resumé* of the leading facts, we now proceed to deal with this question more fully. It appears, then, that, as well as Mr. W. H. Power and Dr. Klein, Dr. Cameron also was concerned, though in a less degree, in the investigation of this disease which occurred in milch-cows at Hendon, and gave rise to scarlatina in persons using the milk supplied from that dairy.

Now, this Hendon cow disease presents some points in common with a malady of cows called erythema mammillarum,

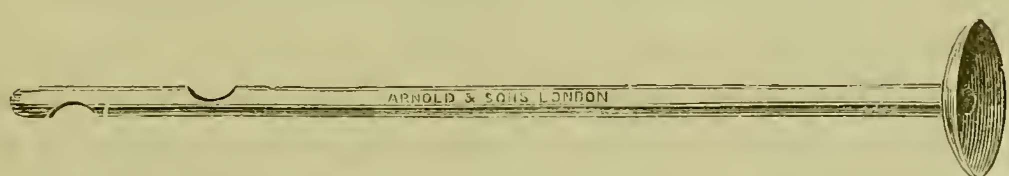


FIG. 40.—MILK OR TEAT-SYPHON.

This milk-syphon is constructed for the purpose of abstracting milk from the teats of a cow.

or sore teats. As in the case of the Hendon disease, so also in that of this latter malady, cows which have recently calved are those affected, and the ulcers on the teats and udder may in both diseases assume a very sluggish character. The disorder varies in intensity, sometimes affecting the gland tissue itself. The calf should be removed and fed by hand, and the milk should be drawn off daily by the aid of a milk-syphon, and, of course, rejected.

The attendance of the veterinary surgeon should be sought, and he may probably administer in the first instance one pound of Epsom salts, at the same time prescribing or supplying a

suitable antiseptic application to be applied to the parts. An ointment may be made of extract of belladonna, one part; boric acid, two parts; carbolic acid, half-part; benzoated lard, thirteen parts.

A disease called scarlatina has also been described as appearing in the ox; but probably it is the general fever, of which "sore teats" are local manifestations. It is spoken of as an acute inflammation of the skin and mucous surfaces, and is similar to purpura hæmorrhagica, the disease next to be discussed, though in this last-mentioned disorder the mucous membranes of the nostrils and other parts are more markedly swollen. Moreover, in scarlet fever these lining membranes are covered with red points, whereby a scarlet hue is imparted, while in cases of purpura, infiltrations of blood are seen. About two days after the onset of the fever, there is an eruption of minute spots on the mucous membranes of the eyes, nose, and fauces, and these spots form bright scarlet patches. The eruption, which terminates at about the seventh day, is most easily seen in those parts which are covered with thin skin, and have but little hair; for instance, the nose, axilla, and udder. Where there is much cellular tissue, the parts swell, and if the swollen parts are pressed upon pitting is generally produced, but pain is not caused. The bowels are constipated, and albumen is often present in the urine.

It is in the fifteenth annual report of the Local Government Board that we find the official account of the very striking simultaneity found to exist betwixt the occurrence of scarlatina in various districts of London and the milk supplied from a dairy farm at Hendon. At a certain time scarlatina had undergone a sudden and notable increase in certain districts in London, and a strikingly large proportion of the recorded cases had occurred among persons who proved, on inquiry, to be customers of a milk retailer dealing in this particular Hendon milk. It was found that especial pains had been taken to render this farm at Hendon, as the phrase goes, sanitarily perfect. Drainage, cleanliness, and ventilation of the house, the farm-yard, the cow-sheds, and the dairy, had all been thoroughly attended to. All needful appliances for thorough cleansing of dairy utensils by hot water or steam were at hand. Dr. Cameron had furthermore specially attended to the health of those employed about the farm and

the children of the employés. The farmer had carried out every suggestion made to him; and, in short, he had taken every precaution to secure his farm and his milk against any known fault. He had a separate shed for any sick animal, and another separate shed for newly arrived animals, wherein they could be observed before being added to the large sheds.

After a most searching inquiry, it seemed probable that the scarlatina had not arisen from any faults in the water or the drainage, nor to careless handling of milk or milk-utensils by persons who might thereby have conveyed to it the virus of scarlatina, but that the cows themselves must have had something to do with it; and this conclusion did not seem to be put out of court by the confident affirmation that for months past not one of the cows had suffered any illness. Now, it transpired that on November 15th three cows which had recently calved had arrived from Derbyshire and been added to the dairy farm, and it was known that the first occurrences of scarlatina had taken place at about the end of that same month.

The exact date at which the milk of these cows had been used could not be elicited. True, they were placed in the general cow-sheds towards the close of the month; but very probably their milk, as was customary, had been used while they were still quartered in "the quarantine shed." Possibly, then, we may conclude that a week may have elapsed between the arrival of the cows at the farm and the distribution of their milk to the districts supplied, and thus, the period of incubation of scarlatina being less than a week, the approximate coincidence in point of time between the use of this milk from the three cows aforesaid and the occurrence of scarlatina in the four milk districts was most remarkable.

There were, however, far more exact concurrences between the distribution of the milk and the occurrence of scarlatina, and thus Mr. Power at length reached the point of excluding external scarlatina, of associating the importation of particular cows into the Hendon farm with the presence of scarlatina in London districts, and of connecting the milk furnished by those cows with the peculiarities of the prevalence of scarlatina among consumers of the Hendon farmer's milk. It was thought that the cows added on November 15th had some kind of cow disease, probably of an infective nature.

At Christmastide case after case of scarlatina occurred near the farm among the labouring class and the poor. The first case had begun on December 20th. Now, on December 15th sixty-three barn-gallons of milk, mainly derived from cows in the large shed, had been returned to the farmer with an intimation by the Marleybone Health Officer that he believed some of the milk had been causing scarlatina in his district. This milk was consigned to the pigs, and orders were given that all the milk of the large shed should, with the exception of some to be used for pig-feeding, be thrown into a pit in one of the farmer's fields. However, as was perhaps not unnatural, poor neighbours begged to be supplied with it. It was refused; but certain of the cow-men gave some of it away gratuitously, thinking that otherwise it would be wasted. About a week afterwards the terrible Nemesis appeared in the shape of scarlatina. It invaded about six families, a large proportion of those to whom the milk had been supplied, and it attacked no family to which the milk had not been supplied.

It was found that there were sores on the teats and udders of the cows in the large shed. Two of the three cows which had been received into the dairy on November 15th were found to have scars on their teats and udders, whereby they were seen to have had the malady, and other cows were noticed to be suffering, or to have the marks of having suffered. Dr. Klein regarded the disease as a constitutional one, and capable of being communicated from cow to cow. Finally, the whole milk of the farm was given to the pigs or buried.

The malady is, according to Dr. Cameron, a specific contagious and infectious disease occurring usually amongst "newly-calved" cows, and capable of being communicated to healthy cows by means of virus conveyed by the hands of a milker who has been milking a diseased cow, and by the discharges from a diseased cow's mouth, nose, and eyes. It has, perhaps, been communicated to man by inoculation, and also by the medium of the milk. In the cow there is general constitutional disturbance, a short fever, a hacking cough, quick breathing, sore throat in severe cases, discharges from the nostrils and eyes, an eruption on the skin around the eyes, and also on the hind-quarters, vesicles on the teats and udders, alteration in the milk, and internal lesions. The disease is continued for a period of about five weeks, or may

even last three months. Cows which have recently calved seem to be especially liable to the disease. Perhaps they have been in bad condition before calving, or they may have slipped their calves, or possibly portions of the membranes have been retained, and the animals thus debilitated have been a ready prey to the germs of the malady.

The bowels are rather loose, and the urine is scanty and high-coloured. About six days after the beginning of the illness, one or more teats become enlarged, swollen so as to be nearly double their natural size, puffy, and not at all hard. Little bladder-like spots next appear upon the red and greatly enlarged teats and on the udder. There may be about three of these on one teat. They are about the size of a pea, and contain a clear fluid. They break and leave raw sores or ulcers, which are red or pale, and have raised edges. In about two days' time the little bladders have become ulcers of about half an inch in diameter. Shortly after being broken, a reddish-brown scab begins to form in the centre of the sore and extends towards the margin. These scabs may remain attached, perhaps twenty-five days, or even as long as six weeks. A watery fluid exudes from under the scab, and about six days after the ulcers have become covered with the scabs, they gradually heal up, leaving a whitish, flat, indistinct scar.

About six weeks after the cows had been first attacked, the scabs varied in size from a shilling to that of a florin; the skin beneath was of a pearly-blue colour and slightly hardened, but not depressed. After the vesicles had broken and the scabs had formed as described above, the swelling of the teats gradually subsided. The margins of the ulcers were not raised, and there was no perceptible redness of the skin around them. In some animals an ulcer here and there was seen on the lower part of the udder.

It may be observed that in the case of cow-pox a hard spot first appears, and then becomes bladder-like, while pus develops in it. In the centre of the little bladder-like elevation (vesicle) there is formed a depression with raised pearly-looking edges, with hardening round the margin, and with a distinct areola. In the case, however, of this disease which we are considering, the vesicle seems to appear at once without being preceded by a hard spot, without the development of pus, without the central

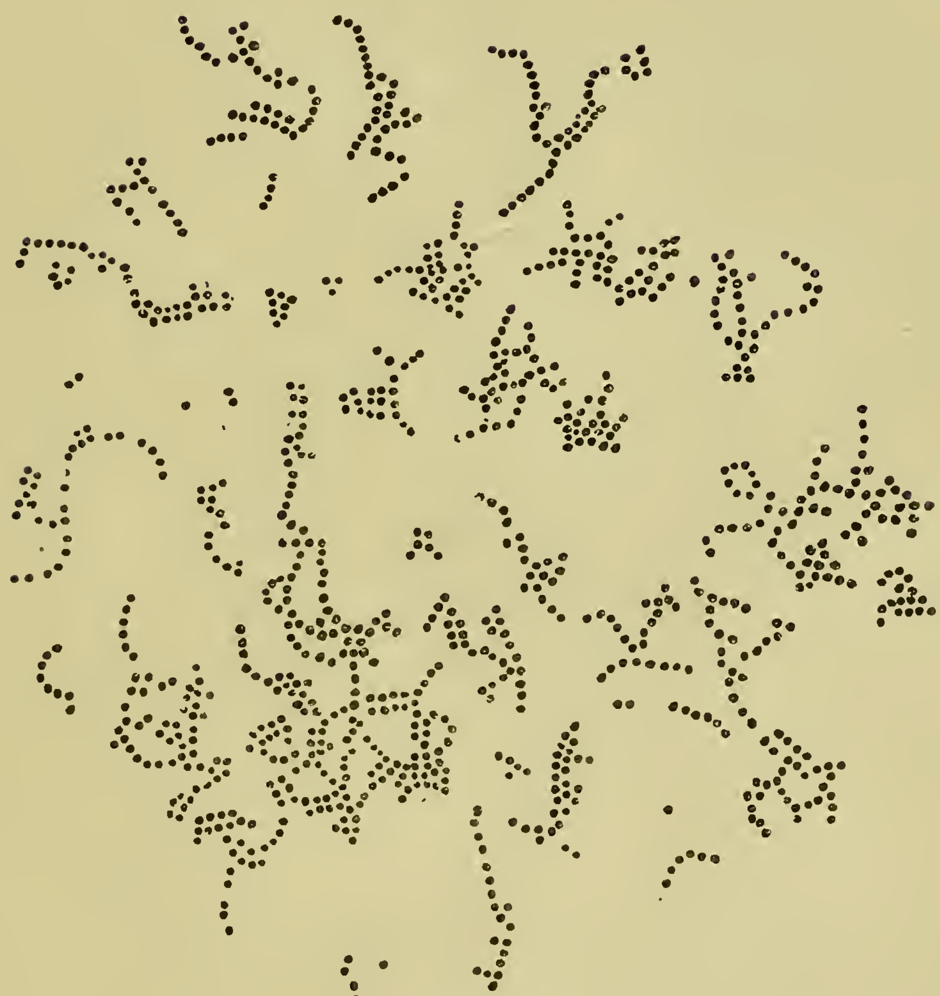
depression, with no hardening at the margin, no areola, and finally when the scabs have fallen off, there is no pitting of the skin. There are, therefore, essential points of difference betwixt cow-pox and this malady, which by the medium of the milk of the cows suffering from it gives rise to scarlatina in men.

Portions of the skin, especially of the tail and back, were denuded of hair, and the epidermis was rough and scaly. One cow had several scabs in the skin of the back, redness of the vagina, and on the teats and udder there were brownish crusts, which, when removed, left a firm sore, which, when squeezed, gave out a rather thick lymph. Two days after the greatest development of these sores, when they were diminishing, the animal was killed. When the chest was opened, numerous red spots were seen in the upper posterior lobes of the lungs, underneath the pulmonary pleura. In the liver there were several reddish patches, which reached from the surface to a depth of about a quarter of an inch. In the placenta there were numerous purple spots. In another cow there were, as in this one, many of the peripheral lobules of the lungs congested and also pleural adhesions. The outer part of the kidney was also congested.

Dr. Klein has found the streptococci on which the disease depends. He has, moreover, inoculated subcutaneously two calves with sub-cultures of these streptococci, and the result was that they had a disease closely resembling human scarlatina. Now, as to the milk. If at an early stage of the disease it is set aside for some hours, it becomes thick; but it seems that in some cases it is only the first few "draughts" of the teat which bring this slimy milk, and it is not characteristic of the malady, since "ropiness" of milk is to be noted in several disorders of the cow. For instance, it has been noticed in the case of milk which apparently gave rise to diphtheria in consumers. The pure milk apparently does not contain the streptococci which produce the disease; but it is very liable to become contaminated by the hand of the milker, and, if once introduced into the milk, they would readily multiply in it.

For the present we may say that such milk is, in all probability, a most fertile source of the dissemination of scarlatina in our midst, and the dangers hence resulting are the more insidious on account of the fact that the cow disease, whence

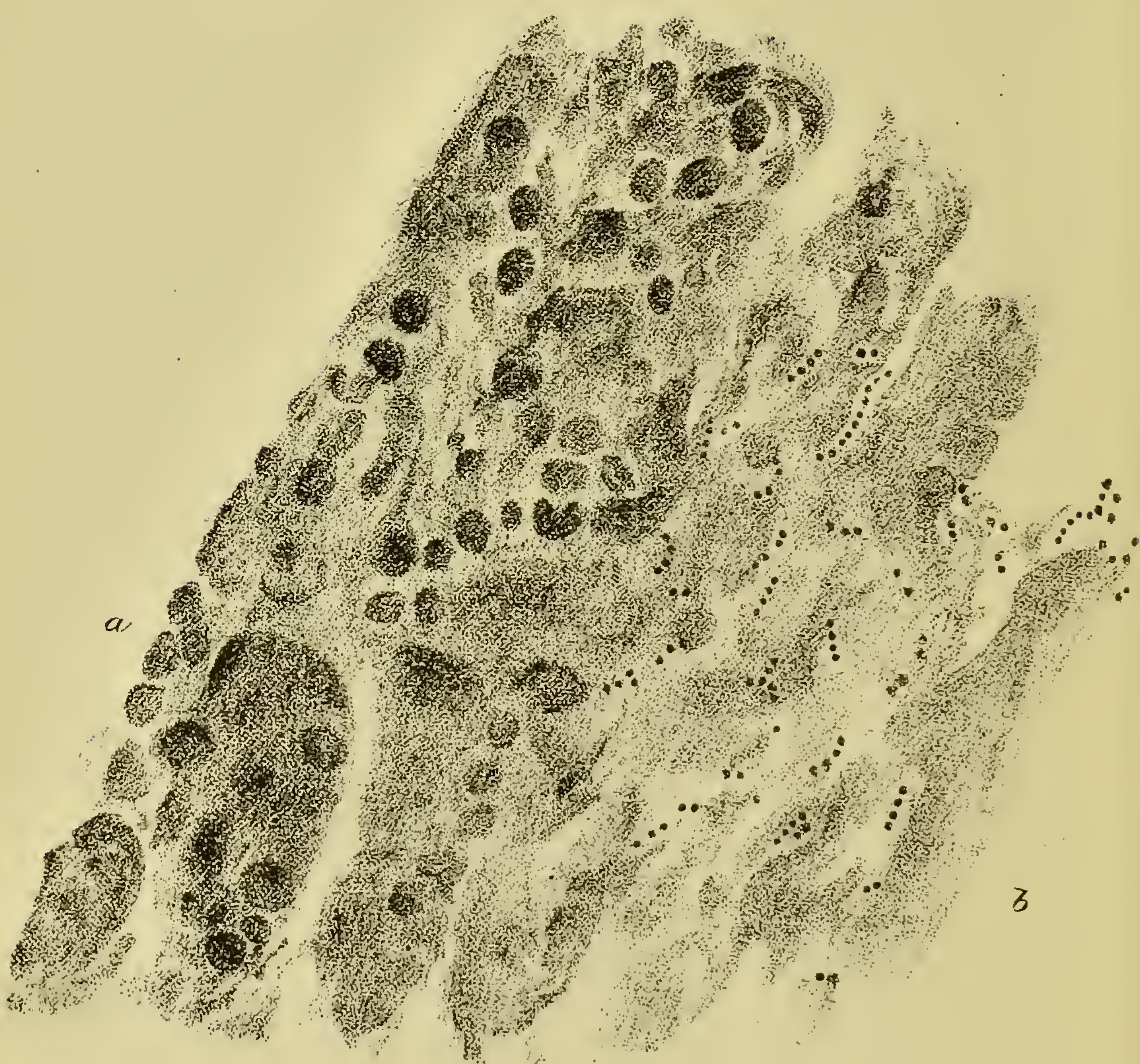
MICROCOCCUS SCARLATINÆ.



Streptococcus Scarlatinæ from the growth of the Scarlatina Micrococcus in the clear *fluid* collecting in a test-tube at the base of the slanting surface of solid Agar-Agar mixture.

Magnif. power about 1100.

MICROCOCCUS SCARLATINÆ.



Some of the superficial cavities of the Stratum Malpighii—

a. Round cells filling the cavities.

b. Diplococci and Streptococci.

Magnif. power about 1100.

such liability springs, is of such a character that it has not hitherto attracted much attention on the part of cow-keepers, not being a very dangerous disorder in so far as their cows are concerned.

We see in the *Times* of May 28th, 1887, that Dr. Klein delivered a lecture in London on the subject of the transmissibility of scarlet fever from the cow to human beings, and in relation with this disease he described the micrococcus scarlatinæ. He also spoke generally on the very important question of the communicability of other diseases, such as diphtheria and typhoid fever, to man, through the agency of contaminated milk. There was also a leader in the *Times*, May 28th, on this most important subject.

Hence, judging from the above considerations, we find that there has been observed a very striking coincidence between the occurrence of a certain disease in cows on the one hand, and of scarlatina in human beings who have ingested the milk of these cows on the other. Moreover, Dr. Russell, of Glasgow (*vide* the *Lancet* of May 26th, 1888) has investigated an outbreak of scarlatina at Garnet Hill, and has adduced therefrom evidence in support of the same view. He has proved that the milk of a particular dairy was to be traced in connection with a large number of cases of scarlatina, and also that the milk of certain cows was in all probability the actual cause of the distribution of this disease. Moreover, he excluded the possibility that the milk might perchance have been rendered infective by the medium of human beings employed in milking or in the distribution and supply of the milk. Some cows presented appearances resembling those described as characterising the Hendon cows, and water-colour drawings of the teats of the Hendon cows were very similar in look to the teats of the Glasgow cows. Furthermore, a calf fed on the milk of these cows was almost immediately seized with a highly febrile illness from the effects of which it nearly died, but finally recovered after losing hair and copious casting of the skin. Lastly, Dr. Carmichael cultivated micro-organisms obtained from these animals. Further very striking, and indeed conclusive evidence in support of the connection betwixt scarlet-fever in human beings and a similar disease occurring in cows is to be found in the account of Dr. Klein's further researches, which we now proceed to consider.

In Appendix B, p. 367, of the Medical Report for 1886 contained in the Sixteenth Annual Report of the Local Government Board, Dr. Klein records the results of experiments in connection with the etiology of scarlatina.

He says that in his report of the previous year it was shown that in the ulcers on the teats and udders of the affected Hendon cows a micrococcus was found to be present which, when grown on nutritive gelatine, Agar-Agar mixture, blood serum, broth, and milk, possessed certain definite distinguishing characters. By means of cultivations of this micrococcus, cutaneous and visceral disease was produced by subcutaneous inoculation, and this disease in many of its characters resembled that of the viscera in the Hendon cows, as well as that of the viscera in cases of human scarlatina. Now the points which presented themselves for determination were whether or not the peculiar micrococcus observed in the Hendon cows occurs in cases of human cases of scarlatina, and if so whether or not this micrococcus, when derived from human scarlatina, is capable of producing the same disease in calves as had been seen in calves inoculated with the cultivations of the micrococcus taken from the Hendon cows.

With the view of settling these questions, Dr. Klein examined a number of acute cases of scarlatina at the Fulham Fever Hospital.

The part from which the blood was taken, namely, the tip of the finger or the skin of the arm covered with the rash, was well rubbed and washed with a strong solution of carbolic acid, and then dried with a clean cloth. By means of a piece of tape, venous congestion of the part was produced, and the skin was well pricked with a clean needle. As the blood came out on the withdrawal of the needle, it was at once received in a capillary glass pipette freshly drawn out and having a pointed end. The withdrawal of the needle, and the rising up of the blood into the pipette were as nearly as possible simultaneous, so that there was very little chance of any accidental introduction of air germs into the blood received into the pipette. Then a test-tube plugged with sterile cotton-wool, the surface of which was well charred, and containing solidified sterile nutritive gelatine, and presenting a slanting, large surface, was inverted, the plug was half or two-thirds drawn out with the sterilised forceps, and

the pointed end of the capillary pipette was pushed through the remainder of the plug until it came opposite and near the surface of the gelatine. Then a drop of the blood—but not the whole of the blood present in the pipette, lest germs possibly present in the breath should also be blown on to the gelatine—was blown on to the gelatine and spread out on its surface by means of the pipette. Then this latter was withdrawn, the plug pushed back to its former position, and the test-tube again placed upright. In the same way other similar test-tubes were inoculated with the same pipette.

In other cases only one test-tube was thus inoculated from the capillary pipette, the other test-tubes being inoculated by means of the platinum-wire, according to the method of Koch. This is as follows :—The test-tube which has received the blood on to the surface of its gelatine—" the stock test-tube "—and another test-tube which is to receive the blood are inverted, the cotton-wool plugs are withdrawn with sterile forceps from both, and with the end of a sterile platinum wire, previously heated and allowed to cool, a droplet of blood is transferred from the first tube into the second, and spread over the surface of the gelatine in this latter, the cotton-wool plug is put into the gas flame and held there for a few seconds, and then replaced into the mouth of the test-tube. Then a second, third, fourth, &c., test-tube is inoculated from the stock test-tube in the same manner.

In the case of a post-mortem of an acute case of scarlatina, the pericardial cavity is opened with clean scissors. Immediately afterwards the pointed end of a freshly drawn-out capillary glass pipette is pushed through the wall of the right ventricle or right auricle, and blood is drawn up into the pipette. The mode of inoculation of test-tubes from this is the same as before. The same method of taking the blood by means of the capillary pipette from the cavity of the heart direct is used in the case of animals which had died in consequence of the disease, or had been killed while the disease was running its course. In all these experiments six, eight, twelve, or even more, tubes containing sterile nutritive gelatine with slanting large surface were inoculated. It was remarked that when from a particular case of scarlatina a positive result was obtained, there were always only a very few of the culture-tubes in which any growth

occurred. When a bacterial growth did occur, it did not appear until the third, fourth, or fifth day, in gelatine tubes kept in the incubator at a temperature of 20° C., and there was only one, or there might be two, or at the most three, minute colonies. In fact, the blood of patients affected with scarlatina contains only a few organisms. If we make a series of cover-glass preparations after the Weigert-Koch method—using about as much blood as would be contained in a culture-tube—and stain with gentian-violet, methylen-blue, or other dyes, and examine with a high-power oil-immersion lens, it is only rarely that we see in one or other such specimen a stained granule or a dumb-bell of such a size that it may be looked upon as being presumably a micrococcus or a diplococcus of the species that we find by cultivation does exist in the blood of patients affected with scarlatina. The scarcity of these micrococci is a peculiar feature of scarlatina as opposed to anthrax, septicæmia, &c., in which the particular germs are found in considerably quantity.

A micrococcus similar to that obtained from the Hendon cows was obtained from the blood of four human beings suffering from scarlatina, and also after death from the blood taken from the heart of a fifth patient who had died in consequence of the affection. In the case of the living persons from whose blood the micrococcus was obtained, the temperature was at its maximum at or about the day on which the culture experiments were made. In three of the four experiments on living scarlatina patients from whose blood an organism identical with that found in the Hendon cows was recovered, there developed in the culture-tubes, besides the colonies of the special micrococcus, colonies of other micrococci also; and Dr. Klein states that if he had not been familiar beforehand with the appearances of the particular organism obtained from the Hendon cows, he would have had great difficulty in identifying it in these specimens of blood. Moreover, the other micrococci of these three scarlatina cases were much more easily discoverable than was the one which was common to all five of the cases of scarlatina, and which were known as occurring in the Hendon cow disease. In order to prove the connection between a disease and a particular organism, it is necessary to reproduce the same disease by inoculation of suitable animals with specimens of that particular organism proved to be free from admixture with any other organism.

The sub-cultures of the special organism obtained from the cases of human scarlatina are identical in all respects with those obtained from the Hendon cows. In plate cultivation they appear after three, five, or six days as minute greyish-white, translucent circular colonies, not larger than the point of a pin. They only enlarge slowly, and as a rule they take weeks and months to reach a size larger than the head of a medium-sized pin. They are then slightly thicker in the central than at the marginal portion.

On the surface of solid alkaline nutritive gelatine, of solid blood serum, of solid alkaline Agar-Agar mixtures, the growth is a greyish translucent film made up of isolated translucent greyish circular dots.

After some weeks or months the film is still thin, translucent, greyish. The marginal dots have become much larger and flatter than those in the middle parts. The former are not quite circular, but more or less irregular, and in old cultivations they are fringed and serrate.

In alkaline broth or alkaline broth peptone the growth forms whitish or greyish-white fluffy or loose masses at the bottom of the tube. In milk the organism grows fairly well, and turns the milk at first thick, then quite solid. Sometimes this occurs already after two or three days' incubation at 37° C., sometimes a little later.

The observed characters of the micrococcus, which is present in cases of human scarlatina and in the Hendon cow disease, point to the fact that it is morphologically distinct from any other known micrococcus, and that it has a definite mode of existence. In sections of the tissues taken from a young girl, aged two and a half years, who died of scarlet fever, micrococci were found *e.g.* in the cervical lymph glands, in lymph spaces, and in small blood-vessels, in the inflamed glomeruli of the kidney, and in the small blood-vessels of the enormously engorged lung. Examination of the lung-tissue in three instances revealed that many lobules were enormously congested, the capillaries of the alveoli being much distended by and filled with blood, while in many alveoli blood was seen to be extravasated, the epithelial cells of these and neighbouring alveoli being detached. Dr. Klein also examined some old sections through the skin of patients who had suffered from scarlatina. They were made and mounted in

1876, and when examined afresh after having been stained with Löffler's methylen-blue they revealed the presence of numerous micrococci, singly and as diplococci, and as short chains which were found in the tissue of the skin papillæ, and especially between the deepest cells of the stratum malpighii, whence they could be traced between the epithelial cells upwards towards the superficial layers of this stratum.

Dr. Klein has also proved by experiments that the action on mice of the micrococcus scarlatinæ derived from a human source is the same as that from the cow, and also that house-mice are more susceptible to its action than tame mice are; and he also states, basing his remarks on other experiments, that there can, then, be no doubt that both by inoculation and feeding with cultures of the micrococcus scarlatinæ, derived from the human source, a definite general disease in calves, cutaneous and visceral, is produced, and that this disease bears a great resemblance to that observed in the Hendon cows, and observed also in calves inoculated with the micrococcus derived from those cows. However, it is to be observed that there were no ulcers on the soft skin of the belly in these calves; while, on the other hand, the condition of the pericardium was not examined in the Hendon cows. From these experiments we thus learn that with the cultures of the micrococcus scarlatinæ of a certain patient, both by inoculation and by feeding, the identical and typical disease, cutaneous and visceral, was produced in calves, and, further, that the pericardial exudation contained the micrococcus scarlatinæ more abundantly than the blood, for while inoculations made from the blood of the heart did not produce any growth in three tubes, each of the three tubes inoculated with the pericardial exudation yielded colonies of the micrococcus scarlatinæ.

In all the animals which died or were killed in the course of Dr. Klein's experiments, after they had been infected with the micrococcus scarlatinæ of one source or another, the condition of the viscera was seen on microscopic examination to resemble that found in the viscera of cases of fatal human scarlatina. Dr. Klein has also found the scarlatina micrococcus in condensed milk, and also that the cultures of this micrococcus had the same effect as that derived from the Hendon cows and from the cases of human scarlatina, and that it was successfully recovered by

MICROCOCCUS SCARLATINÆ.

Section through KIDNEY of a mouse experimentally infected with Micrococcus Scarlatinæ, derived from a particular brand of condensed milk—

a An interlobular cortical artery.

b Extravasation and masses of round cells.

c Malpighian corpuscles; congested and nuclei much increased in number (Glomerulo-nephritis).

d Disorganised convoluted tubules.

Magnif. power, 100.

cultivation from the heart's blood of the animals dead as a result of the inoculation or the feeding.

It was clear that the action of the cultures of this micrococcus of the condensed milk upon calves after feeding or inoculation is identical with the action of the cultures of the micrococcus derived from human scarlatina.

Finally, from observations in regard to a monkey which died at Wimbledon during a scarlatina outbreak there, it was proved that the cultures of the micrococcus derived from the Wimbledon monkey, and which proved to be identical in morphological and structural characters with the micrococcus scarlatinæ, acted on mice in precisely the same manner as those of the micrococcus obtained from the Hendon cow and from the human source. Also, like the latter, the cultivated organism acted more decidedly on house-mice than on tame ones.

MALIGNANT CATARRHAL FEVER. PURPURA HÆMORRAGICA. TETANUS.

The Rev. Dr. A. Jessop, in the March number of the *Nineteenth Century*, 1887, writes:—" 'How often do you give it meat?' said a blushing, mild-eyed, lank-haired young worthy in my hearing the other day. 'Lawk! sir, that don't have no meat,' answered the laughing mother, as she hugged her tiny baby closer to her bosom. 'Never have meat? How dreadful!' "

Scientific treatise without an anecdote or something to relieve the weighty monotone of science—how terrible! Neverthless, in the space at our command it is difficult to bear in mind always that our pen must not be a heavy one if we are to do real and lasting good. None knew this better than Sir Walter Scott, who, at the close of his first chapter of *Waverley*, points out that the moral lessons which he would willingly consider as the most important part of his plan, will certainly fall short of their aim if he should be found unable to mix them with amusement—a task not quite so easy in this critical generation as it was "sixty years since." Indeed, there are but few writers who have not realised how stringently necessary it is to catch the public eye, if they are in any way desirous of doing good work for the people.

In this connection the words of the Rev. J. G. Wood, in the same number of the same review, are so good as to bear reitera-

tion. "The object of language," writes this well-known and deservedly popular scientific author, "is to convey ideas, and I have always held that words are valuable in proportion to their power of conveying thought from one brain to another. A word, therefore, which can be understood by ten thousand hearers should always be used in preference to one which only three or four individuals can be expected to comprehend. A lecturer should always bear in mind that his true object is to teach his hearers, and not to impress them with awe of his vast attainments. Nothing is easier than to employ the technical phraseology of science. The real difficulty lies in conveying the same information in language which every one can understand."

It is very true that it is very easy to employ the technical phraseology of science, and at the same time it is very difficult to interpret great scientific facts and generalisations in language which can be understanded of the people. Few authors, except those who, like Professors Huxley and Tyndall and the Rev. J. G. Wood, try to speak and write about science in the ordinary language used by the Englishman of good general education can know how arduous a matter it is to effect this object.

The fact is that the coining of new words, often quite unnecessary ones, is proceeding so quickly, that, if things go on as at present, science will soon have a special language of her own, which will serve effectually to mystify and perplex all but her eager votaries. This would be a result greatly to be deplored, and, we say it with all respect, will be in a large measure owing to a certain pride on the part of not a few leading scientists, no less than to the want of the literary habit, unfortunately noticeable in the rank and file of the mightly legions of workers now engaged in the clearing up of the many mysteries which beset us on all sides.

To-day we have to deal with the three disorders above-named in so far as they afflict bovine animals, and in so far as is possible in the limited space at our command. It may be said that they are not of such primary importance as to need a very minute description at our hands, and we add that, although we hope to be able to make this instalment of our subject an interesting no less than a valuable one, we cannot but anticipate that it may be found no easy task to do so. Hence we must crave the

indulgence of our kind readers while we promise to do our best to show them the way over three rather awkward fences.

Malignant Catarrhal Fever of the Ox.

This malady which first demands attention expresses itself by a greatly disturbed condition of the membrane which lines certain cavities in the head and nasal chambers, which are known as " sinuses." When afflicted with malignant catarrhal fever, the ox is seized with shivering fits, and has a dull look. The

Figure 41.

The above picture represents the appearance of an ox suffering from the early or first stage of Malignant Catarrh. The animal separates itself from its companions in the pasture, looks dull, holds the head low, and the mucous membranes are of a bluish-red tinge. The ox cannot bear the light, and the eye is well seen in the illustration to be closed and swollen, and the tears to be pouring down from it in profusion. The muzzle is hot, and the salivary secretion and the d scharge from the nostrils may be copious, as is well shown in the above drawing. The animal gives utterance to a cough indicative of pain. The pulse is accelerated, as also are the respirations. The ox is thirsty, but has no appetite.

membranes which line the nostrils, mouth, and so on, become bluish-red, the eyes close, the eye-lids swell, and tears flow over the cheeks. The animal is troubled with a frequent and painful cough, and its pulse is enfeebled. At first the bowels are constipated, but diarrhœa soon comes on.

The disease is rapid in its course, so much so that even a few hours after its commencement a profuse discharge issues from the nostrils, mouth, and eyes. The sinuses of the face and head above referred to become full of purulent matter, and sometimes

also the horns drop off. There is indeed an intimate connection between the bone of each horn and the corresponding frontal sinus of that side of the head. The projection of bone, which springs from the crest of the frontal bone, and forms the *basis* or *core* of the horn, is hollow, and the cavity within it is continuous with the cavity known as the frontal sinus. The interior of this bony *core* of the horn is provided with an extensive supply of blood by means of blood-vessels which are connected with those of the frontal bones; consequently the inflammatory process which is going on in the blood-vessels of the frontal bones extends itself to those which are present within the *core*, and from them to the surface of this bony basis of the horn. Inflammation leads to suppuration, and thereby the detachment of the horns is brought about.

The disease, which is of a very fatal character, causing death in from three to seven days, is said to be non-contagious, and to result from inflammation coming on as a consequence of exposure to cold. The animals which are attacked by the disease should at once be removed to warm sheds, wherein they are to be tended with every care. The veterinary attendant should be called in, and he will probably proceed to take measures to open the bowels gently by the aid of enemas, or such simple aperients as oil or treacle. In the early stages either stimulants, such as the carbonate of ammonium, or the acetate of ammonium, or spirit of nitrous ether, are required. Moreover, it is well to cause the animal occasionally to inhale the steam from boiling water, to which oil of eucalyptus or carbolic acid has been added in small proportion. If the patient survives seven days, it will probably gradually recover, and the best remedial agents will consist in tonics, good food, and studious attention to the animal's general wants during the stage of convalescence.

Purpura Hæmorrhagica.

This malady, which is not so commonly met with in cattle as in the horse, and is more liable to affect calves than older oxen, is probably likewise not contagious in its nature. It has been considered to be allied to anthrax, which disease it simulates in many points, though, so far as is yet known, not in the most important of all, viz. the presence of bacilli in the blood. So

far as we know, no bacilli have been as yet found in typical cases of purpura. The malady we are speaking of is an eruptive fever of an intermittent type, which seems to result from exposure or inhalation of foul air, and it frequently attacks an animal which is already debilitated by the ravages of another disease, such as catarrhal fever. Purpura hæmorrhagica, or purpura, as it is more briefly named, is a specific blood disease in which the skin, the mucous membranes, the connective tissue of the lungs and kidneys, and the coats of the intestinal walls are mainly affected.

The earliest symptoms may show themselves in the form of pain in one or more limbs, together with slight swellings, which soon become more prominent. There may be a few purple or dark-red spots in the nostrils, and perhaps papules (or spots) may make their appearance on the skin at the outset of the disease. The blood is intimately affected in some at present unknown manner. It seems to be thinner than usual, and there is an escape of it, or of red serum, or of both, into the surrounding tissues, and especially on the mucous and serous membranes. It is difficult to say how this leakage occurs; but it must necessarily be due to some deficiency in, or giving way of, the walls of the blood-vessels, or to the gaining of new powers of permeating these tissues, by which it is normally enclosed, on the part of the blood itself. The disease brings in its train pronounced debility. The temperature may suddenly rise to as much as 106° F., or even higher, and the changes of temperature are very great.

Hot and rather circumscribed swellings, which evidently cause pain, appear in various parts of the body, and from them, and also from the nostrils, a reddish fluid flows. Those swellings which are situated on the mucous membranes of the respiratory and alimentary tracts of course interfere with, and impede in greater or less degree, the processes of breathing and swallowing. The heart's beats are weak and fluttering in character, and the pulse is small and dicrotous (double).

After the disease has pursued its course for about a week, the animal may indeed gradually recover its strength; but more frequently the poor creature gradually sinks and dies. If the body of an ox which has died from the ravages of this disease be carefully examined, red spots may be seen on the serous and

mucous membranes, and the tissues generally will be found to be largely infiltrated with blood and serum.

With regard to treatment, the strictest cleanliness must be enjoined, and the patient should be supplied with food which is at once nutritious and easy of digestion. The veterinary surgeon should have recourse to stimulants. Oil of turpentine is indicated, owing to its special action on the kidneys and its stimulating properties. Tincture of perchloride of iron is of especial value, and suitable preparations of ergot are very useful at times. Sulphuric acid in small doses well diluted with water has also been recommended, but its use requires confirmation. Continued care is requisite, for not only is the period of convalescence lengthened, but the disease is also liable to recur.

Tetanus, or Locked-Jaw.

Our readers will readily understand that the above-named disease is one in regard to which, although a great deal has been written, yet not very much is as yet really known. When suffering from tetanus, an animal exhibits a general and continued spasm of the muscles of the body. Not only is this characteristic state of contraction seen in the case of those muscles which are immediately under the direction of the will, and are therefore called voluntary, but also in those which are termed involuntary, owing to the fact that they are not usually brought into play by the will of the animal. Generally speaking, horses are more liable to be afflicted with tetanus than are either men or cattle, although the disease is not very uncommon among human beings in the tropics, nor is it very infrequent among calves and sheep.

Tetanus may come on either after an injury has been sustained, in which case it is called *traumatic*, or from other causes, such as the ingestion of bad food or exposure to cold, wet, inclement weather. If it occurs in an animal which has not sustained any wound, it is designated *idiopathic*. We may here state that quite recently it has been stated that tetanus is really caused by the presence of germs of a definite kind, and that the symptoms are due to an alkaloid called tetanine. (Brieger). The disease is said to arise in lambs when the ewes are feeding upon rich trefoil, and it may be noted that cattle which are prone to receive injuries, such as working oxen, are

more liable to the malady than those which are subjected to less risk in this respect.

An ox suffering from tetanus may exhibit slight dulness, loss of appetite, cessation of chewing the cud, and difficulty in moving. The attitude of the animal is characteristic, and almost at a glance the disease can be detected, perhaps more readily, however, in the case of a horse than in that of an ox, since in the former animal one is more ready and less surprised to see the signs of tetanus, directly they present themselves. The hind-legs may probably be wide apart, the whole body and neck and limbs are, as it seems, stiffened, the nose is protruded, the head and tail are elevated, the respiration and pulse are both quickened, and the nostrils are expanded.

In nearly all cases the mouth cannot be opened, and this fact has given rise to the ordinary name by which the disorder is known, viz. lock-jaw or locked-jaw. When the head of the animal is raised, the *haw* rapidly passes over the eye-ball, which is at the same time retracted into its orbital cavity. The bowels are constipated, the muscles of the body twitch, swallowing is a difficult process, and the abdomen is rigidly contracted. All the muscles of the body seem to be more or less strongly affected; but different sets of muscles are liable to be especially attacked, making, for instance, the back curve upwards or downwards, as the case may be, or causing a bending of the animal to one or other side of the body. The contortions of the body are frequently of a very marked kind.

One very important point to be borne in mind is that any causes which tend to cause excitement, such, for instance, as sudden noises, presence of people in the building, admission of light, are to be carefully avoided, while comparative darkness, or at any rate stringent exclusion of any piercing light, should be strictly enjoined. If the attack is of a very severe kind, the patient quickly sinks, despite all attempts to obviate a fatal issue; but if the animal, by dint of the greatest care and most skilful attention, lives over the seventh day, recovery *may* ensue. The patient may show signs of thirst, and by the medium of fluids may be induced to take in a fair amount of nutriment. This, however, is one of the greatest difficulties in treating cases of tetanus; for manifestly it is of the first importance, when so much energy is being wastefully expended by reason

of the incessant contractions of the muscles, that the loss of tissue should be made good by a plentiful supply of new material.

In case the animal is to be treated, the bowels should in the first instance be acted upon, and all irritating objects should be removed. If there is a wound, it is advisable to dress it with some palliative mixture, or with a poultice to which some bland substance has been added. The patient should be secluded, and only a moderate amount of light should be admitted, the windows and other apertures being nearly always kept closed.

Recently tetanus has been said to depend upon the operation of a specific germ, and no doubt this statement will be found to be true. There can be no doubt that the continued breaking out of the disease, which we have often observed to occur on the same premises, lends the strongest *à priori* probability to this view, as does also the general analogy which exists between tetanus and certain maladies which are known to depend upon the presence of germs. Yet, as we have often pointed out, a great deal of investigation is still required in these and allied fields of research. Whatsoever may be the cause, it is at least evident that the nervous system is intimately connected with the manifestations which are exhibited. The phenomena of the disease must be looked upon as resulting from abnormal working of the structures concerned in the primary development of force in the organism, *i.e.* of the nerves and nerve centres.

The continuous or almost constant state of tension in which the muscles exist in this disease leads us to suppose that the products of muscular action—such substances as sarcolactic acid, for example—are largely present in the various tissues and in the blood ; and the great success which has followed our treatment of tetanus in horses by means of alkaline salts, coupled with other remedies, is no doubt explicable on this hypothesis. Some years ago this method of treatment was commented upon by Mr. J. B. Gresswell (*vide* the *Veterinarian* of October 1882), and it has since that time been endorsed by other veterinary surgeons. Of course there are also other most valuable remedies, such as bromide of potassium, tobacco, and perhaps hydrate of chloral. However, it may be said that there is no more difficult malady to treat in the whole range of animal disorders than tetanus. This has given rise to the erroneous

popular notion that it is no use trying to save animals suffering from lock-jaw, and that "a horse with lock-jaw is as good (*or rather as bad*) as a dead one." On the contrary, the percentage of deaths, provided that careful and judicious treatment is carried out, should not be much higher than in other diseases.

As we have said above, the alkaline salts, the bromides, and the preparations of the alkaloid, nicotine, have, when used with the greatest possible care, proved highly successful in the case of tetanus in the horse. In the ox, however, the disease is not so common, and the various remedies have not been thoroughly tried. The difficulties of treating tetanus are enhanced by the fact that, when the jaw is greatly locked, the only admissible methods of administering medicines are that by subcutaneous injection, or that by means of a tube passed round the back molar tooth.

It only remains to add that the flesh of oxen which have suffered from any of the above three diseases ought not to be used as food.

The very painful and frequently fatal disease known as tetanus, or locked-jaw, is often manifested in SHEEP at first by the forcible closing of the mouth, and it shows itself by constant spasm of the voluntary muscles, especially those of the jaw, neck, and spine. In sheep the disease is usually first shown by a peculiar involuntary spasmodic movement of the head, or of one or all the extremities, together with a grinding of the teeth and a fixedness of the jaw. Then the sufferer becomes very stiff all over, the neck is protruded, and the head kept forcibly bent upwards. One leg may be drawn up and fixed in an unnatural position; moreover, violent convulsions of the head, neck, and extremities may occasionally be observed, and after the convulsions have subsided, a rigidity of the parts may be seen. So suddenly fatal may tetanus be, that often even within twelve hours from the time of being attacked the animal may be dead.

The disease may occasionally break out in sheep which have been shorn, and hence these animals should be kept without food for a few hours before the process of shearing is carried out, and after it they should be sheltered for about a week. Otherwise tetanus, or inflammation of the lungs, or erysipelas may supervene. Thousands of ewes, after lambing, and even

tens of thousands of lambs lately dropped, have repeatedly been lost in severe winter weather owing to the want of care, and in some cases to the entire absence of shelter. The only wonder is that so few, comparatively speaking, are lost. After exceptionally cold nights some of the ewes and more of the lambs are often found dead in the morning. In some cases, where no more effectual protection can be had, the providing a simple shed or other shelter—even a clump of trees is better than nothing—to which the sheep could gain access during a storm, would be sufficient for their wants. Again, in the case of sheep, castration is attended with far more risk of tetanus than is that operation in the case of horses.

By way of treatment, one or more doses of castor oil or of Epsom salts may be administered. If it is practicable to do so, the patient may be placed in a warm bath, and then thoroughly dried, wrapped in blankets, and then kept very warm. Gruel, to which gin has been added in suitable quantity, may be given. Alkalies, tobacco, and bromide of potassium, administered carefully and in suitable doses, are the most efficacious of the remedies which have been recommended for cases of tetanus in other animals; but they have not been extensively tried in the case of the sheep.

RHEUMATISM, OR FELON: JOINT FELON, CHINE FELON, COLD FELON.

In times past, when man had no knowledge of disease, and in his ignorance could find no light to guide him onward, he believed, as does the untutored savage still, the most weird and grotesque conceptions of the maladies incident to man and the creatures over which he dominates. The belief in wizards and witches, in accordance with which thousands of innocent creatures, even men and women, have been cruelly massacred outright, or tortured by slow degrees to agonising deaths, is prevalent at the present time among most savage tribes, and seems to have been evolved to account for the subtle agencies which surpass man's power of comprehension and explanation on any other hypothesis. In our country, indeed, the belief in witches and wizards did not become extinct until comparatively recent times. It is not, therefore, to be wondered at that many diseases to which creatures are subject have been put down to the

influence of witches and wizards, or to some evil spirit or spirits entering or dominating over the individual affected. As knowledge spreads, and the mind begins to grasp the true relationship of man with his environment, it is soon perceived that '*out of the heart* proceed evil thoughts and all that *doth defile.*' (Matt. xv. 18).*

Rheumatism in the ox, of which we have now to speak, is a disease even yet better known by country-folk under the terms felon, chine felon, cold felon, joint felon. The word felon is derived from the root *fall,* connected with *fell,* "cruel," an epithet applied to one who commits a cruel deed, or a felon, and it is not improbable that in days gone by people thought an ox affected with rheumatism was the victim of some living agent desirous to harm their cattle from spite or revenge, or even in just punishment for misdeeds. In the names of some diseases of man we can trace direct relationship of the popular term with that of the cruel agency to which man in his striving ignorance assigned it.

The term rheumatism denotes a peculiar kind of inflammation affecting the joints, muscles, or fibrous tissues. It is due to some general morbid condition, and has an especial tendency to migrate from one part of the body to another. Rheumatism is either of an acute or chronic variety, and in the ox this term is also inclusive of some painful affections of a neuralgic character; and, indeed, rheumatism and neuralgia are probably very intimately connected. Rheumatism or felon in the ox generally comes on after exposure to wet or cold, and the disease is especially common in severe boisterous weather. Vicissitudes of weather, indeed, are the chief exciting causes of rheumatic affections. Cold draughty sheds (in exposed situations) are too frequently answerable for causing them in milch cows.

It must be pointed out that certain animals especially show a marked predisposition to contracting rheumatic affections, and this, too, is the case with man in the absence of any other cause. This special predisposition is known as the "*rheumatic diathesis.*" It will be readily understood that bad management of cattle, causing derangements of the digestive and assimilative functions, is a powerful predisposing factor in the causation of

* "But those things which proceed out of the mouth come forth from the heart; and they defile the man."

the malady. In damp, low-lying districts the disease is more commonly met with than in more elevated spots, and in variable climates it is especially prevalent.

Some observers have supposed that rheumatism is the result of infection by some germ. In man there is no doubt that rheumatism may manifest itself in a considerable number of ways, as Dr. Cheadle has lately shown; for instance, as Pericarditis, Myocarditis, or Endocarditis, as Chorea, and as new formations, the histological elements of which are those of the granulomata, *i.e.* small nuclear bodies in the meshes of a delicate network formed by stellate cells. Whether these new formations are to be found in animals or not has not yet been determined, nor has the question been more than entertained as to whether these nodules contain micro-organisms. It is quite possible that minute and searching investigation may lead to the discovery that such is the case.

Some of our readers, no doubt, are pretty well acquainted with the usual symptoms of rheumatic affections in the cow. They are as a rule sufficiently manifest even to a casual observer. The only thing which is sometimes apt to deceive one is the apparent insignificance of the symptoms in some badly marked cases compared with the gravity and length of time the inflammatory action may last before subsiding. In the acute variety the suffering animal generally first manifests irritability and uneasiness. The appetite is diminished or fails altogether, and rumination, or chewing the cud, may be suspended. The skin is harsh, and the mouth is dry and parched. Other symptoms of the febrile disturbance are acceleration of the pulse, which may reach as high as 80° to 100°; constipation, which is very general, and rise of temperature. In an ordinary case the thermometer reaches about 103° to 104° F., and when it exceeds this, the attack is of a severe character. It not uncommonly reaches 105° F., and we have known it as high as 106° and 107°. The water passed, which in healthy herbivorous animals is alkaline, becomes acid.

The first factor which generally leads one to diagnose the case as one of rheumatism is the occurrence of painful swelling of some joint or joints, more commonly the knee or hock, or the two hocks, or two knees, or one hock and one knee affected simultaneously. The animal manifests lameness in proportion

to the acuteness of the inflammation. Sometimes the inflammation is confined to the tendons of the muscles which bend the leg (flexor tendons), and very commonly it attacks the coverings of the muscles of the thoracic walls. If the affected tissues be pressed upon, the animal manifests considerable pain, the muscles being very tender.

There is a special tendency of the rheumatic inflammation in one joint to disappear somewhat suddenly and appear in another joint. This tendency on the part of the inflammation to shift thus, is spoken of as "*metastasis*." The internal lining mem-

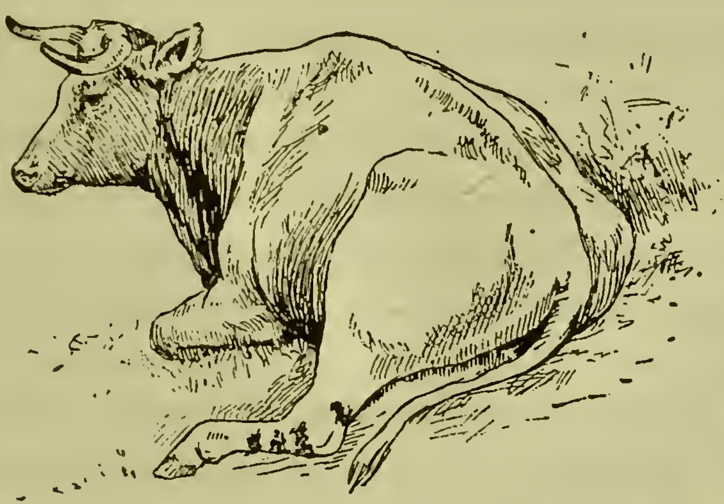


Fig. 42.

The above picture (after Armatage) well shows the appearance presented by an ox suffering from the malady known as rheumatism. The left hind-leg is seen to be kept so situated that it may as far as possible remain perfectly at rest, this near hind-leg being specially the seat of pain. The countenance of the animal is downcast and expressive of resigned suffering, and the illustration is altogether designed to depict that special kind of helplessness to move without causing great pain, which is one of the most marked characteristics of acute rheumatism.

brane of the heart (*endocardium*) and the external membrane or sac (*pericardium*) in which it is enclosed, are sometimes attacked by the rheumatic inflammation, and the valves thus become involved in the disease. After the rheumatism is cured, the valves of the heart often remain permanently diseased, and in this manner most cases of heart affection have their origin in the ox. In some instances so severe is the inflammation of the lining membrane inside the heart that the animal succumbs during the acute stage of the rheumatism.

When the valves of the heart are affected, or when any structure of the heart becomes involved, the pulse assumes a different character. As a rule, in such cases it becomes quick and

irregular, and is often felt to be intermittent. The sounds of the heart also are altered in character, giving rise to "murmurs."

A case of acute rheumatism varies in duration from about one to three weeks or more, excepting when it passes into the chronic form, which may last for months. In the chronic form there are as a rule no marked febrile manifestations, and, indeed, fever may be in many cases entirely absent; the heart is rather rarely affected in this variety. Chronic rheumatism, as we have seen, may be left as a sequel after subsidence of the acute symptoms, and may be of a chronic nature from the outset. It is more persistent than the acute variety, and there is far less tendency for the inflammatory action to shift from place to place than in acute rheumatism.

In the general way, chronic rheumatism, when chronic, so to say, almost from the outset, is confined to two corresponding joints, or at times to one limb at any rate. The joint itself becomes much enlarged; it is stiff and painful, and, as the inflammatory action spreads, it may become locked and immovable, owing to the growth of bony excrescences. The "cartilage" (gristle) of the joint may become ulcerated, and the ends of the bones entering into its formation may become much enlarged owing to the growth of bony tissue around them. The general disturbance of the animal may not be great, but loss of appetite and loss of flesh are sometimes occasioned. Chronic rheumatic enlargements are often met with affecting various bones, such as the vertebræ of the back and neck, and in these situations they may form large bony growths. The bones of the pelvic or hip girdle are often affected, and indeed the growths may occur almost anywhere. The muscular walls of the heart sometimes show a deposit of calcareous matter.

In those cases in the ox, unfortunately not very rare, where the tissues below and above the enlarged joint become much swollen, pus or matter is sometimes formed, and the animal wastes rapidly from the discharge of matter, and he thus becomes valueless.

We have lastly to turn our attention to the consideration of the treatment of the forms of rheumatism. It is advisable to commence the treatment of cases of this kind in the ox by the administration of a moderately active purgative; sixteen ounces of Epsom, or Glauber's salts, with one ounce of powdered cara-

way seed, may be dissolved in a couple of pints of warm water, and administered with an ordinary drinking-horn. We may here mention that a horn, the base of which is cut off so as to make a long ovoid opening, is the most suitable vessel for employment in drenching cattle. The animal's head should be raised a trifle above the level by the garthman who stands on the left side, while the administrator pours the medicine into the pouch which he forms by drawing aside the cheek on the opposite side.

If the head be elevated much above the horizontal, there is risk of choking the animal, and it is therefore best to administer medicine in the way directed, and to allow the animal time to swallow each mouthful before giving a second. For this reason we prefer the horn to the drinking-bottle, which holds a pint to a pint and a half, seeing that with the horn it is possible to give a few fluid ounces at a time, and rapidly, and to allow the animal to take its own time in swallowing. Of course the bottle may be used, if care be taken not to give the medicine too rapidly. In fact, the bottle should be removed from the mouth at frequent intervals of time.

The diet should be very carefully regulated ; at first it should be light and nutritious, consisting of mashes, hay, grass, or other green food ; in the later stages, when the febrile symptoms have abated, plenty of good food is essential, the malady being of a very debilitating nature. The animal should be well bedded, as very frequently, especially in the case of cows, the recumbent posture is generally maintained in the febrile stage. The bedding should be frequently changed to keep the animal as dry and clean as possible. Twice daily, a drench, consisting of salicylate of sodium four drachms, bicarbonate of potassium one ounce, may be given in a pint of water for four or five days, or as long as the acute symptoms last. In more chronic cases half an ounce of nitrate of potassium may be given instead twice daily in water. In very acute cases, British pharmacopœial tincture of aconite in doses of twenty minims may be given with salicylate of sodium and bicarbonate of potassium. Oil of turpentine is a favourite popular remedy for the more chronic cases of rheumatism ; but it is not of great value.

Regarding local treatment, the affected joints, if very painful, should be fomented with warm water, and liniment of turpen-

tine and belladonna assiduously applied. The joints should then be wrapped up in flannel, after being dried. If the joint gives extreme pain, it must be smartly blistered at the outset with ointment of cantharides. When the heart is affected seriously, the prognosis is very bad. When matter forms in the joint, or near to it, it is best to have the animal slaughtered, as treatment will be seldom beneficial, and the animal will lose flesh rapidly.

In those instances where the sides are very painful, in which cases we speak of the felon as pleurodynia, and there is no further serious mischief, the animal must be kept warm, and fed upon easily digestible diet. The sides should be rubbed over with turpentine liniment, and, if there be any fever, the salicylate of sodium and bicarbonate of potassium drench may be given twice daily for three or four days.

It is always well to remember that rheumatic cases are apt to prove lingering, and it is therefore necessary not to be impatient, if recovery seems more tardy than might have been hoped. A great number of cases of disease in oxen set down to countless other maladies are in reality nothing more nor less than rheumatism, either in the joints of the limbs, the joints of the trunk, or in the coverings of the muscles. An animal recovering from rheumatism requires tonics, if much debility is exhibited. In such cases a drench may be given once or twice daily. One ounce of gentian, one ounce of ginger, one ounce of fenugreek, and one of aniseed, may be prescribed, and given dissolved, or rather mixed, with a pint of ale.

ANÆMIA: ITS CAUSES, CONSEQUENCES, NATURE, AND TREATMENT.—FOOD-SUPPLY OF THE COW.

It was Goethe who wrote, "Every beginning is difficult; but, difficult as the initial stages of any subject prove to be, they are overcome with far less effort than the finishing touches." This generalisation is very true, and it is especially applicable in the case of the diseases and disorders of the ox. It is not the general points regarding them which present much difficulty to the careful observer; but it is the clearing up of the many uncertainties which chiefly engages his attention, and puts the resources of his knowledge to so keen and sharp a test.

The writer recollects, a very long time ago, when quite a small

boy, he was busily engaged in contemplating the many and varied illustrations in an encyclopædia of many volumes, and he well remembers being told that when he grew up, he would be able to obtain information on every subject imaginable in those closely-printed picture books. Much has been done since that day ; but look into whatsoever encyclopædia or book one chooses, one will not find a very great deal to enlighten him regarding some of the most important features of the diseases and disorders of the ox. He will find the plagues of cattle lengthily described, and massive monographs of some of them will be at his disposal ; but regarding many other diseases of the ox the information obtainable will be of the scantiest imaginable.

It is indeed a pleasure to us to have now finished our review of the germ diseases of the ox ; may we hope we have not proved wearisome. Some of the points on which we have laid stress have been the result of many years' practical labour on our part and painstaking, many have been known for a length of time, and many have been culled from the accounts of recent researches made during the past few years by enthusiastic workers engaged in investigating the diseases of the ox and of other creatures. One is often told that he need not aim at always investigating new facts, and listening to or reading of new discoveries of the causation and cure of disease, for the simple reason that such knowledge has frequently to be too soon remodelled under the chastening scrutiny of still further and deeper investigations. So it has ; but yet, though the *beginnings* are not perfect, and though the *finishing touches* may make them assume new and possibly altogether different aspects, have they not been the foundation-stones of the building, and, even if not in every case permanent, did they not serve a temporary function until replaced by firmer structures ?

The writer recollects how, when quite young, he first heard the wonderful doctrine of Darwin expounded in simple language by a learned graduate. After listening patiently for some time, he inquired, "Yes ; but tell me, does Mr. Darwin himself believe his own theory ? " The question evoked a laugh of mingled scorn and pity, and the answer sharply, " He neither believes nor disbelieves ; he merely propounds it." But the question was not so absurd as one might suppose ; for, as in the case of the points we have brought forward with relation to the

diseases and disorders of the ox, a writer must necessarily be under a positive or a negative impression regarding every theory, or generalization, or set of facts, he records. The question arises :—Are, then, so many human diseases, such as tuberculosis, anthrax, scarlet fever, actinomycosis, and others, in reality derivable and derived from the ox? Our previous articles speak more or less definitely in the affirmative; and we believe, as do many others, regarding some or all of them, that they are in reality transmissible from the ox to man.

Our readers will, therefore, perceive that the germ diseases of the ox are not only of importance *in themselves*, but are also of still more intense importance in the relation they bear to the diseases of *man*. The veterinary surgeon has a great and important duty in this respect (and the physician, in his aspect of the question, has even more responsibility than he); and no matter whosoever underrates his function, this truth stands out boldly, and still in bolder relief *will* assert itself in the interests and welfare of mankind. The comparative pathologist, be he physician, surgeon, scientist, or veterinarian, is on the verge of great discoveries; some—many—have already been made; let him press on; his beginning was difficult; his finishing touches will be far more so; but let him be of good cheer.

We have now to treat of the first of the disorders of the ox which depend on errors of diet; and we shall commence by speaking to-day of anæmia. By this term anæmia we signify a condition in which there is a deficiency in the number of the red blood corpuscles and in the amount of other solid constituents of the blood. Although but rarely met with in North Lincolnshire, anæmia is of too frequent occurrence in many parts of England, and is a disease of which all cattle-owners should have some knowledge. The diseased condition may be induced whenever the food is too scanty in amount or of inferior quality.

Some time ago Mr. J. B. Gresswell was called to a number of cows in calf; they were manifesting symptoms of extreme debility and prostration. One of the number had already succumbed, and two of the others lay prostrate on the ground, with hind limbs paralysed. The local attendant had diagnosed the cases as being of an infectious nature; but they were in reality purely and simply cases of anæmia, due to the insufficient supply of food, and this was of a very poor quality. Throughout the

winter, with the view of economising, the owner had fed his cows on barley chaff and straw, and in consequence their blood had become poorer and poorer in quality, until symptoms of extreme prostration and paralysis had at length set in, and doubtless all would have soon succumbed, had this feeding been continued.

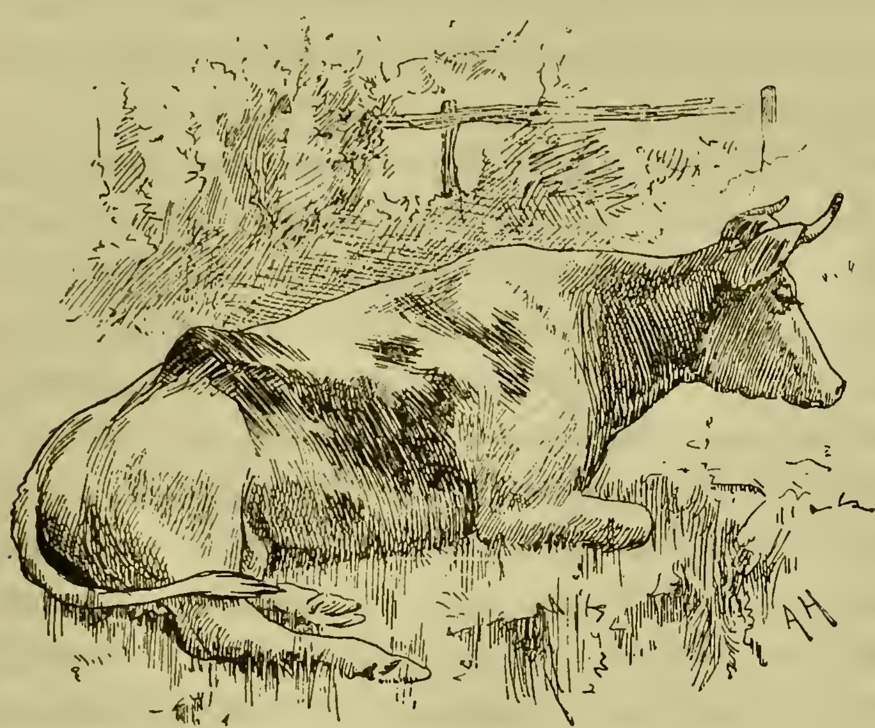


FIG. 43.—NERVOUS DEBILITY IN COWS AT THE TIME OF PARTURITION.

The cow delineated in the above picture is the subject of nervous debility, occurring about the time of parturition. This is a malady due to the functional disorder alone, and it is not as a rule followed by death. Our artist has faithfully represented the characteristic appearances of this disease. The observer will readily note, from the attitude of the cow, that she suffers from general weakness and loss of nerve-power. She is represented as lying in a recumbent posture in the field, but she has now no inclination for browsing on the grass beside her, nor is she represented as chewing the cud, a usual sign of undisturbed health in the case of ruminating animals. She has no delight to move leisurely in the luxuriant pasture, nor does the sweet woodland scenery attract her gaze; but she must needs lie still, the vigorous activity of health having left her—let us hope only for a short time, and that her health will be restored after having taken her with care and gentleness to a dry shed or ox-stall, nicely bedded down with clean new straw, keeping her warm, attending to every want, and administering such remedies as may be found advisable.

Under a more generous regimen and the administration of tonics and stimulants the animals made good recoveries.

This particular form of anæmia occurring in "in-calvers," when symptoms of paralysis set in, is termed pre-parturient paralysis; or paralysis occurring before parturition, and it is not at all uncommon in under-fed cows. Other forms of anæmia, one very rarely sees in Lincolnshire. Among sheep, especially breeding ewes, anæmia is very frequently met with in some parts of

England, and it owes its origin, in these animals likewise, to an insufficient or innutritious food-supply.

Anæmia may also be induced by any cause which acts as a drain upon the circulating blood. Loss of blood by hæmorrhage, or by protracted or debilitating diseases, of necessity impairs the quality of the blood, and induces anæmia. The secretion of too large quantities of milk often also acts as a drain upon the blood, in those instances when the food supply is not correspondingly large; thus anæmia is set up.

Regarding the feeding of dairy cows, four main points, says Mr. Walker, in his *Cow and Calf*, must be kept in view; and so valuable are these hints that we take the liberty of quoting them:—"The first point is to aid the increase of milk; the second, to improve the quality of the milk; the third, to maintain the condition of the cow; the fourth, to produce manure of good quality. Too often the careless dairyman only looks as far as his milk-pail is concerned, and fails to notice that his cow is wasting flesh day by day, until at last the milk falls off, and the animal has to be dried much sooner than she need have been under more judicious treatment. Sweet, well-harvested hay obtained at the latter end of June or first week in July is of the very best quality, providing it is not gathered in too quickly to heat in the stack. Grass cut at this season contains the maximum of sap. Most of the plants are in full bloom, and therefore the crop is in its proper state for cutting. Grass is not the most nutritious when the seed is ripe. Many of the seeds are dislodged in haymaking, and the remainder of the vegetal is woody, indigestible, and innutritious; thus such fodder is particularly unwholesome for the dairy cow. Clover hay, when well got, is supposed to be a better milk-producer than meadow hay; but, as Mr. John Walker points out, this would much depend upon the sort of land the hay was cut from. Howbeit, it is sufficient for us to observe that either meadow or clover hay is wholesome for the dairy cow when well harvested, and must, when the grass season is over, form the principal food. Bran stands high in the list of good milk-producers. It increases the flow of milk, improves its quality, and holds up the condition of the cow, while no unpleasant flavour is imparted to the butter; it is also a cheap diet. This food should be given warm in mash shape, and two gallons per day will be a good allowance with other food."

He also says that oats are very similar in favourable results to wheaten bran, and may be given in quantities of from one to one and a half gallons with other food per day. It is best to have them crushed. Bean and pea meals tend rather to improve the condition of the animal than to increase the milk supply; and as also they may give an unpleasant flavour to the milk, they should be used sparingly with other mixtures. Linseed cake is rich in milk and in flesh-producing qualities. Cotton-cake, when of good quality, is said to be even better; but other writers do not altogether endorse this opinion.

Regarding roots, Mr. Walker says they must be given with caution. Swedes may be allowed in cases where the milk is to be sold; but when butter is made, the flavour is not pleasant if this regimen be adopted. Swedes must be well matured if required for dairy cows, and to accomplish this they should be stored early. Mangel-wurzels are a somewhat over-rated food; before Christmas they are unfit for cows; during March, April, May, and June, they are the most nutritious. Cabbages are good food for dairy cows, and even more valuable are carrots, which are rich milk-producers, and most wholesome. . . . We must now leave these interesting questions and conclude our review of anæmia.

The blood, when examined with the hæmocytometer, shows in anæmic animals a great reduction in the number of red blood corpuscles, and these contain less hæmoglobin, and are paler than those of healthy blood; the number of white corpuscles is perhaps not altered, nor are the fibrin and salts of the serum diminished in amount. The quantity of water in the blood in proportion to the solid constituents is increased.

An anæmic ox shows gradual wasting of the tissues, and becomes thin and wan. The pulse is weak, and the volume of blood passing along the arteries is diminished, while the arteries themselves are contracted. There is gradually progressing weakness, and the animal becomes languid and dull; the appetite is variable, sometimes being very indifferent, sometimes being increased; but it is always capricious and generally much impaired; the breathing is irregular and hurried on the slightest exertion. Much gas is apt to accumulate in the bowels, and indigestion is very often an accompaniment of this impoverished state of the blood. The bowels are generally irregular, being

most often constipated, though they may be too freely opened; diarrhœa, indeed, is not at all uncommon. Dizziness and general depression make the animal look the picture of helplessness and despair. Even cows despair.

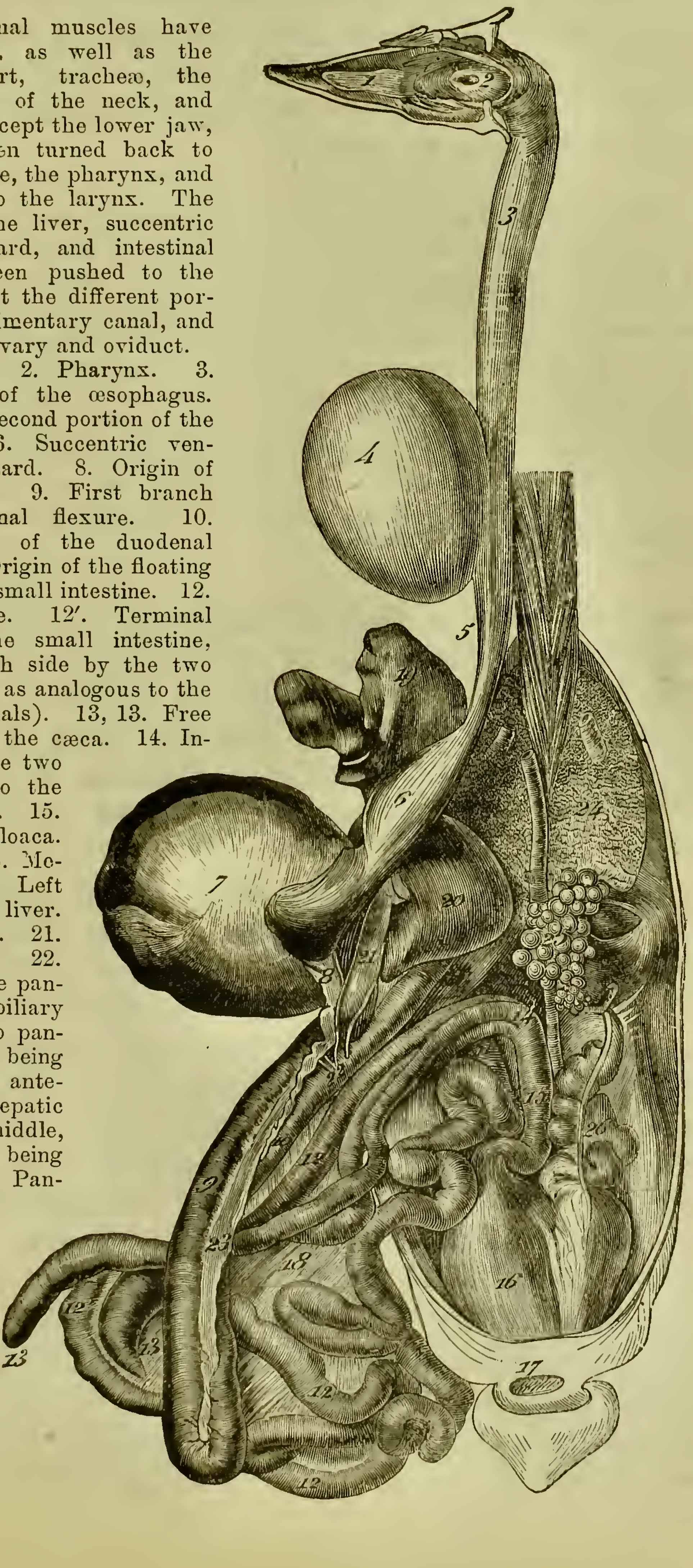
Regarding the treatment of anæmia, we must say a few words. In the first place the cause of the disorder should be ascertained. The food supply should be judiciously regulated in accordance with the requirements of the animal, and should be of an easily digestible nutritious character. Linseed gruel and bran mashes will at first be of great value. If there be any loss of blood, this should receive attention and treatment. If there be no ascertainable cause, tonics should be administered once or twice daily. The most valuable are the salts of iron and vegetable tonics such as nux vomica, or its alkaloid strychnine, and bitters, such as gentian, calumba, and chiretta. The general requirements of the animal must also receive attention; the shed must be well ventilated and kept in a cleanly, wholesome condition. If the place is damp and cold, plenty of bedding should be used. An ordinary case of simple anæmia is easily curable, when treated on these general lines. More severe cases generally owe their cause to some internal disorder, the nature of which must be carefully ascertained.

The treatment of pre-parturient paralysis requires pretty nearly the same management, but the medicinal treatment must be more vigorous. With strychnine and carbonate of ammonium the best results are to be obtained, and but seldom need a case succumb, if it be well attended to. There is no fear of abortion being caused by the administration of these tonics; on the contrary, unless these or other remedial measures be taken, abortion will ensue in many instances. Abortion, indeed, is commonly the result of under-feeding.

GENERAL DISORDERS DUE TO DIETETIC ERRORS.

When one contemplates how fertile is bounteous Nature in resource, and how adaptable men and animals are to the varied conditions to which they are subjected, one might at first, perhaps, wonder that they sometimes battle so unsuccessfully against those many and varied disorders which owe their causation to dietetic errors. Yet, indeed, these diseases, especially common

FIG. 44.—GENERAL VIEW OF THE DIGESTIVE APPARATUS OF A FOWL.



The abdominal muscles have been removed, as well as the sternum, heart, tracheæ, the greater portion of the neck, and all the head except the lower jaw, which has been turned back to show the tongue, the pharynx, and the entrance to the larynx. The left lobe of the liver, succentric ventricle, gizzard, and intestinal mass, have been pushed to the right to exhibit the different portions of the alimentary canal, and to expose the ovary and oviduct.

1. Tongue. 2. Pharynx. 3. First portion of the œsophagus. 4. Crop. 5. Second portion of the œsophagus. 6. Succentric ventricle. 7. Gizzard. 8. Origin of the duodenum. 9. First branch of the duodenal flexure. 10. Second branch of the duodenal flexure. 11. Origin of the floating portion of the small intestine. 12. Small intestine. 12′. Terminal portion of the small intestine, flanked on each side by the two cæca (regarded as analogous to the colon of mammals). 13, 13. Free extremities of the cæca. 14. Insertion of these two culs-de-sac into the intestinal tube. 15. Rectum. 16. Cloaca. 17. Anus. 18. Mesentery. 19. Left lobe of the liver. 20. Right lobe. 21. Gall - bladder. 22. Insertion of the pancreatic and biliary ducts; the two pancreatic ducts being situated most anteriorly, the hepatic being in the middle, and the cystic being behind. 23. Pancreas. 24. Diaphragmatic aspect of the lung. 25. Ovary (in a state of atrophy). 26. Oviduct. (*Chauveau.*)

in man, rarely occur, excepting as the result of the most flagrant and wilful ignorance or carelessness. Mr. Spencer, speaking of physiological development, gives examples of Nature's ample provision for the requirements of animals, and shows how she supplies deficiencies of one part by growths destined to perform the same functions in another.

> The gizzard of a bird [he writes] is an expanded portion of the alimentary canal, specially fitted to give the food that trituration which the *toothless mouth* of the bird cannot give. Besides having a greatly developed muscular coat, this grinding chamber is lined with a thick and hard cuticle, capable of bearing the friction of the pebbles swallowed to serve as grindstones. This differentiation of the mucous coat of the gizzard into a rigid and tubercled layer of horny matter—a differentiation which in the analogous organs of certain molluscs is carried to the extent of producing from this membrane bony plates and even teeth—varies in birds of different kinds, according to their food. It is moderate in birds that feed on flesh and fish, and extreme in granivorous birds and others that live on hard substances. How does this immense modification of the alimentary canal originate?

Spencer tells us there is warrant for the belief that this change of structure arises by direct adaptation, and he mentions in this connection that Hunter habituated a sea-gull to feed upon grain, and found that the lining of the gizzard became hardened, whilst the gizzard-muscles doubled in thickness. Similarly a like change in the diet of a kite was followed by like results.

In the ruminating animals there are several expansions of the alimentary tract which the food enters before reaching the true digestive stomach. These dilatations, which are likewise known as stomachs, serve to store up large quantities of food hastily swallowed, until the animal at leisure can regurgitate and then thoroughly masticate it. Here again, then, we see how Nature with her manifold resources provides means whereby animals become essentially fitted for "the conditions of life under which they live," or for "their environment," as scientists shortly term it. Knowledge partakes of infinity, and the more we gain, the more clearly do we perceive the power and might of Nature to harmonise the lives of her creatures, both animal and vegetal, with the environment in which they are actually placed. But Nature is not to be fooled, and disease is the reward of those who transgress her laws, known or unknown. These remarks, we may say, in passing, apply with tenfold force in the case of

man—man, with his highly differentiated mental capacity; man, designed by his Creator to fulfil a distinct and definite mission on earth, and to accomplish that fixed purpose with which he was sent here to be dominant over the whole animal creation—man, who has but too often little excuse for his wanton recklessness.

We have not at present, however, to treat of the special diseases of the digestive organs, but of five disorders of a general kind, which are not rare in the ox, and owe their origin to dietetic errors. Shortly, we shall speak in detail of the special diseases of the digestive organs; but our general remarks to-day apply equally to all disorders due to mismanagement of the diet. It is of the first importance to the farmer that he make himself thoroughly acquainted with the necessary scientific details regarding the dieting of animals.

The first disordered condition, of which we have now to speak, is plethora. By the term "plethora" we understand a condition in which the blood is rich to excess—a state of the body not uncommonly met with in animals fed beyond the limits of healthy nutrition. It is not the actual bulk of the food taken, but the quality, which is the factor likely to induce the plethoric condition in young, rapidly-growing animals. The dangers of this condition are twofold; firstly, an animal over-fed and insufficiently exercised is especially liable to simple acute inflammation, and not very rarely falls a victim to disease depending upon this overloaded state of the blood; secondly, we have already shown that calves, when fed with too great an amount of food, especially of a nitrogenous character, are very prone to become the prey of the germs of black-leg.

It is said that this disease is especially likely to attack the fattest and best of the herd, and this is due to the remarkable receptivity of a plethoric animal to the growth of the germ. When an over-fed animal shows symptoms of disorder dependent on plethora, the diet should be restricted in amount, and the pasture changed for one less luxuriant. Moderate exercise should be enjoined, and the bowels should be operated upon by a dose of Epsom or Glauber's salts, repeated if necessary. Where the diet has been too nutritious and stimulating, it should be changed for one less so, and it should be restricted in amount if necessary. Never bleed a plethoric animal because he is plethoric;

if he be suffering from any acute inflammatory attack, of course this may be necessary; but the practice of bleeding for the plethoric condition pure and simple is to be condemned from every aspect; moreover, it is very uneconomical, unless indeed it be carried out to a very minute extent for the purpose of fattening the animal. We now turn our consideration to diabetes.

By the term DIABETES we understand a condition characterised by excessive urination. It is generally associated with great weakness, extreme thirst, and rapid emaciation. In cases of diabetes mellitus, sugar is found to be present in the urine, whereas in diabetes insipidus, sugar is not present in the urine, and this affection is sometimes designated polyuria. Diabetes insipidus, a disease not by any means uncommon in the ox, is generally caused by some dietetic mismanagement; the food supply as a rule has been defective or of inferior quality, or, in other instances, from being very badly supplied with food, the animal has suddenly been placed upon a more liberal allowance of nutriment. In the latter instances the assimilative functions become deranged, and diabetes results. It must be emphatically pointed out that this form of diabetes is not a disease of the kidneys, as it is very frequently supposed to be.

Of all causes of diabetes mellitus the most common is indigestion, and in such cases the malady is, as a rule, more especially amenable to treatment. The disease may also owe its origin to intrinsic or constitutional causes. The urine discharged by a diabetic cow has a sour odour, and it is voided in excessive amount, and the animal becomes very weak and languid, and rapidly loses flesh. The appetite is generally voracious, and the animal eats almost anything within reach. The bowels are irregular, and are frequently constipated and filled with wind (tympanites). Some cases of diabetes progress rapidly from bad to worse, others are of a more chronic character. The tongue, as a rule, is furred, and the breath has an unpleasant odour. Even death may result, if the loss of flesh and consequent exhaustion continue.

The first essential in the treatment of this malady is very careful investigation of the food supply, and even though no fault may be detected, it may be necessary to adopt a different regimen. It is on change of diet that we have chiefly to rely in our treatment of diabetes. In the first place, it will be necessary

to open the bowels by the administration of sixteen ounces of Glauber's salts dissolved in three gills of warm water, and to see that the bowels continue fairly active.

In many instances diabetes is due to indigestion, and in consequence it is our practice to follow up this treatment by the administration of drugs which will enhance the tone and activity of the organs of digestion. With this end in view, one ounce to one ounce and a half of bicarbonate of potassium or of sodium may be given three times daily in the drinking-water, and a draught containing half a fluid ounce of tincture of nux vomica, one fluid ounce of spirit of ammonia, and half a fluid ounce of spirit of chloroform may be given in half a pint of warm water twice daily for four days, then once daily for several days. If this treatment be found ineffectual, iodine is the only remedy likely to prove of value. It is given in drachm doses, with two drachms of iodide of potassium and three drachms of tincture of nux vomica, once daily, in three gills of water. It may be continued for a week or ten days in bad cases. We have not in this place to speak of indigestion and tympanites, excepting in so far as they bear on diabetes; but we shall treat of them in detail later on. We may mention in passing, however, that hyposulphite of sodium is the most valuable drug in cases of simple tympanites in the cow.

We have next to consider two diseases of the bones, due to faulty assimilation, dependent upon dietetic and mal-hygienic causes. The first of these is rickets. By this term we understand a condition in which the bones, owing to defective ossification, are soft, and, being incapable of bearing the weight of the animal, become twisted and contorted in certain ways. Rickets is essentially a disease of young animals. The disease is abundantly common in young badly fed children, especially those living in the slums and back alleys of our large smoky towns. Rickets depends upon defective assimilation of food, and the bones and other structures become deprived of their proper supply of nutriment. Nutritious diet of a good and wholesome kind, exercise in the open air, and thorough ventilation of the shed, are the necessary remedies. Tonics, such as the salts of iron and phosphates, may also be required. The administration of phosphate of calcium, once daily, in the food, is the best treatment for young calves, in which the disease is

due to inherited tendency. When, however, there is no hereditary taint, and the disease probably depends upon indigestion, bitters and alkaline salts, as bicarbonate of potassium and sodium, are frequently useful. Easily digestible nutritious food is always necessary.

It is not often that an animal manifests rickets at birth; the diseased condition usually becomes manifest as the young creature develops. We have not seen the disease in old oxen; but in them a similar disorder is said to occur sometimes, and to be due in such instances to a deficiency of lime in the drinking-water.

Very many lambs die from the effects of the disease called rickets every year that comes, although, of course, the number of those which fall victims depends upon the character of the season, the nature of the locality, and the general management to which they are subjected.

A lamb afflicted with this disease may, when about three weeks old, walk with an uncertain gait, be perhaps slightly lame on its hind-legs, and manifest some difficulty in rising from the recumbent posture. After another week or two have elapsed, the hind-legs may become quite unmanageable, and, as each day comes, the animal experiences greater and greater difficulty in rising, and if the lambs which are affected are suddenly startled they will, if they are not already lying upon the ground, fall down helplessly. As we have said, the weakness increases, and before long the animal has not the power of following its mother, nor can it partake of her milk. In fact, it is reduced to feeding upon any grass which may be within reach, and this being very limited in amount, it pines away and at length dies. Indeed, it is often the best plan to slaughter the lambs when they are in the early stages of the malady.

The disease is probably occasioned by a deficiency of food or of earthy salts in the food, or by the milk of the mother being defective, or taken in insufficient quantity. The bones of the hind-limbs soften and bend, not being able to support the weight of the animal. Moreover, the malady may break out after the animals have been too much confined, or it may show itself as a sequel to other illnesses. In all probability it is capable of being transmitted hereditarily. Hence rams which have been the sires of lambs suffering from rickets should not again be

employed, and ewes which have given birth to unhealthy lambs should be culled.

It is of the highest importance that both the rams and ewes should be in vigorous health, and also that the number of ewes proportionally to the rams should not be too great. It is also very advisable to put the flock in winter-time on sound land, at yeaning time to provide good shelter, and to bestow extra care on, and give an extra supply of food to, those ewes which have twins. If rickets should manifest itself among the flock, all the sheep composing it should be at once supplied with fresh food; and, if it is practicable to do so, they should be put on a richer pasture, or at any rate supplied with cake or sound corn. In fact, a change of diet is a most important preventive and precautionary measure.

It seems that the disease which broke out among the lambs in the district of New York in the spring of the year 1862 was somewhat allied in character to the one above described under the name of rickets. In that case the lambs suffered heavily in consequence of a malady, the particulars of which are to be found in the *Edinburgh Veterinary Review*, vol. v. 1863, page 105. The lambs referred to were wanting in physical development when born. Their bodies were small and lean, or had a peculiar flaccid feel, as if the muscles had not attained their normal consistence. The bones were smaller than is usual, the back and neck were thin, the legs slender, the head was small, the face very thin, and the wool and the hair were very thin and short. The general appearance was like that of an animal prematurely born. Some, indeed, were so feeble and weak that they never could rise to suck; some lived for a few moments or hours, some from two to seven days. They were dull, only made feeble efforts to feed themselves if their dams were at all shy, and many would scarcely even follow their dams about. Very few attained to ordinary size, even if their supply of milk was plentiful.

In some cases congenital goître accompanied the preceding symptoms. A few lambs when born were found to have their heads and necks so drawn down, and occasionally so greatly twisted sideways by the action of the muscles, that they could only suck with difficulty, and by assuming unusual postures. Those which were most severely affected starved, *i.e.* unless

they received assistance from the shepherd until such time as they had gained the power of making the unusual exertions required of them. So suddenly did the disease manifest itself, that even strong and healthy lambs a week or two old, all at once, almost, lost the use of their legs in a greater or less degree. Some hobbled about, as if they were lame in every foot, scarcely being able to walk at all. Some of the suffering animals recovered in a few weeks' time. Others, again, were unable to stand, even when placed upon their feet; yet they looked healthy, fed heartily when assisted to do so, and recovered when the weather became warm. However, notwithstanding the recoveries which took place, even as many as 90 per cent. of some flocks died from this disease.

Mr. Randall says that the flocks of sheep in New York were much more than usually confined during much of the winter from 1861–62. Very deep snows fell about the first day of February, and the hard crusts left on the ground prevented the sheep from straying from the immediate neighbourhood of the stables as long as the spring. In fact many flocks scarcely moved fifty yards from their stables during the last ten or twelve weeks of their pregnancy. Their appetites were kept keen by the cold, and the large amount of food, coupled with inactivity and advancing pregnancy, made the sheep very quiet and much disposed to remain in their stables. When they had eaten, they lay down on their bedding until they rose to eat again. In fact flocks, habituated to run in pastures in the winter, and to dig down to the grass, were entirely cut off from their usual succulent food. It is a grave mistake to let in-lamb ewes obtain green food by roving about the fields and turnip patches for the first two or three months of their time, and then to confine them rigorously to a small yard and dry food. In severe winters, indeed, this course may often lead to wholesale loss of even the grown animals.

Fragility of the bones, or bone-brittleness, or *fragiltas ossium*, is the other bone disease of which we have to speak. This malady is rarely met with in oxen, excepting in those districts where the soil is of a porous or sandy character, and in some degree barren, such as it is in some parts of Scotland, and on the west bank of the Eden in Westmoreland. In such districts the water does not contain the salts

of lime in sufficient abundance, and phosphates and lime salts are in small amount in both soil and water. The animals rapidly lose flesh, and move about sluggishly and stiffly; the appetite is bad, and the pulse becomes frequent in number and weak. Soon the poor creatures have difficulty in standing; the joints swell, and so brittle do the bones become, that fractures are very common in these cases. The milk as a rule becomes thin and watery, and very deficient in solid constituents; though, in those instances where the cows eat a good quantity of food, it may maintain for some time a fair quality.

In the treatment of this disease, the first thing necessary is to remove the animal to a different soil, and, if possible, to obtain water which contains earthy salts in fair quantity. Good, nutritious food is essential; that containing phosphates is especially valuable. The salts of iron are valuable as tonics; the sulphate or carbonate of iron is useful, but the citrate of iron and ammonium is even better. The latter may be given in two-drachm doses twice daily. Vegetable tonics and the phosphate of calcium are also valuable additions; especially the latter. Our knowledge of this disease seems to indicate that soft water is bad for cows, especially milch-cows.

The last disease of which we have to speak here is goître, a malady which attacks man and animals alike, in districts where the water supply is obtained from the magnesian limestone. It is common in Derbyshire, and is known generally as "Derbyshire neck." It is also common in Switzerland and many other countries, and, although more common in man and sheep, it is sometimes met with in oxen. It consists of an enlargement of the thyroid gland, and the tendency to overgrowth of this structure may be inherited. The treatment of goître consists in taking the animals from the district in which they have contracted the disease, or by supplying rain-water, or water acted upon by the addition of carbonate of sodium, which precipitates the magnesium salt.

ANCIENT MEDICINES—SUPERSTITIONS—CHARLATANRY—POISONS.

Those of our readers who have perused our work on *The Diseases and Disorders of the Horse* (London: Baillière, Tindall & Cox), will remember that we commented upon some

old and very weird methods of treatment of the diseases of animals. In one month's number of Mr. James Knowles' review, the *Nineteenth Century*, for 1887, an article, entitled "Strange Medicines," is contributed by Miss C. F. Gordon Cumming. Under this title the able writer brings forward many very interesting facts indeed, while she compares the methods of treatment of disease until quite recently generally practised in Japan with those adopted by our ancestors in these isles. Her remarks clearly prove that the early part of the eighteenth century in our country shows very little, if any, advancement in medical skill on the ignorance which prevailed at the date of the Norman Conquest. While remarking that so rapidly has the scientific study of medicine been taken up by the Japanese medical practitioners, that the survival of a chemist of the pure and unadulterated old school is quite remarkable, she proceeds to describe the shop and stock-in-trade of one of these remarkably interesting individuals, until recently the representatives of the professors of the medical art in Japan.

In the latter country these ancient relics are fast disappearing, while in the Celestial Empire such empirics still hold undisputed sway. The Japanese vendor whose acquaintance was made by Miss Cumming was a purveyor of *curoyakee*, *i.e.* "carbonised animals; in other words, animals reduced to charcoal and potted in small earthenware jars, to be sold as medicine for the sick and suffering. Formerly all these animals were kept alive in the back premises, and customers selected the creature for themselves, and stood by it to see it baked and burned on the spot, so that there could be no imposture or any doubt as to the freshness of the charred medicine. Doubtless some insensible foreign influence may account for the disappearance of the menagerie of waiting victims and their cremation ground. Now the zoological backyard has vanished, and only the strange chemists' shops remain, like well-stored museums wherein are ranged portions of the dried carcases of dogs and deer, foxes and badgers, rats and mice, tigers and elephants. The rarer the animal, and the farther it has travelled, the more precious, apparently, are its virtues. From the roof hung festoons of gigantic snake-skins, which certainly were foreign importations from some land where pythons flourish." Miss Cumming saw one very fine piece of skin which, though badly

dried and much shrunken, measured twenty-six inches across; but it was only a fragment ten feet in length, and was being gradually consumed inch by inch to lend mystic virtue to compounds of many strange ingredients. The perfect skin must have measured very nearly fifty feet in length. There was also another fragment twenty-two feet long and twelve inches wide; this also had evidently shrunk considerably in drying, and must, when in life, have been a very fine specimen.

A medical work of reference, *The Chinese Repository*, published in Canton, A.D. 1832, states, according to the above-named authoress, that the bones of the dragon are found on the banks of rivers and in caves of the earth, places where the dragon died. The bones of the back, and also brain, are especially prized, being variegated with different streaks on a white ground. The best are known by slipping the tongue over them. The teeth are of little firmness. The horns are hard and strong; but, if these are taken from damp places or by women, they are worthless. From his examination of these so-called relics of the dragon, which prove to belong to many different animals, which in successive ages have crept to the same cave to die, Mr. Moseley points out how some imaginative person probably first devised a fanciful picture of the monster, combining the body of a vast lizard with the wings of a bat, the head of a stag, and the teeth of a carnivorous creature. The whole assemblage of heterogeneous factors has become the stereotyped idea of the dragon in all lands.

Miss Cumming, further on in her contribution, tells us that in the official pharmacopœia of the College of Physicians of London, A.D. 1678, the skull of a man who had died a violent death and the horn of a unicorn appear as highly-approved medicines. Again, in A.D. 1724, the same pharmacopœia mentions unicorn's horn, human fat, and human skulls, dog's dung, toads, vipers, and worms, among the really valuable medical stores. The pharmacopœia was revised in 1742, and various ingredients were rejected; but centipedes, vipers, and lizards were retained. Among the standard medicines quoted in the medical books of Nuremberg of 200 years ago are portions of the embalmed bodies of man's flesh brought from the neighbour hood of Memphis, where there are many bodies that have been buried for more than 1,000 years, called *mumia*, which have

been embalmed with costly salves and balsams, and smell strongly of myrrh, aloes, and other fragrant things. The learned doctors of France, Germany, and Italy, all made use of this eccentric drug, and in the seventeenth century it was found that for true mummies men substituted bodies which had died of contagious diseases. These latter were so prepared with different substances as to pass for the real article demanded. Well may one exclaim "Truth is indeed far stranger than fiction!"

It would, we should imagine, be generally conceded that enlightenment among the general public regarding the diseases of man, and their nature, and the remedies of true value in their treatment, is now considerably more in the ascendency than in the case of animals. We may, perhaps, admit that superstitions are as rife regarding human diseases as regarding the diseases of oxen, horses, and sheep; but any real knowledge of the latter among the general public is of the most elementary, and but too often most erroneous description. We may give an example. There is, according to the rural population, a disease of cattle called the tail worm, also spoken of as the "wolf." It is believed to be discoverable by a softness between some of the joints of the tail. In these cases it is supposed to be necessary to slit open the under surface of the tail, and to rub in a mixture composed of salt, woodsoot, and garlic. Although there is no such disease as tail worm, many well educated farmers and others, strange though it may appear, also believe in the actual existence of the tail worm, and in the necessity for these ill-devised practices.

How many poor cows have their tails slit open in one day in our rural districts it is impossible to say; and even if they escape this indignity, to what others they may not be subjected is a matter of conjecture only. Might we not have expected that scientific enlightenment would have done more, would have opened men's minds to a greater extent than it seems as yet to have done? In one little straggling village alone, in North Lincolnshire, there are three men who practise the ox-healing art; and though no one is qualified, yet they vie with one another in declamations of each other's incapacity. One wonders how men could ever have been led to believe in carbonised python, or in the mummified remains perhaps a thousand or more years old, as specifics against human ills. But is this, we ask, more

strange than the belief that certain much advertised medicaments can cure all the ills human or animal flesh is heir to? Indeed, were we compelled to choose between carbonised python and some of these ill-compounded medicines stated to be able to cure all diseases and disorders of whatever kind, we should prefer the former. This, at any rate, might be harmless; but can we invariably say the same of the latter?

Poisons.

In dealing with poisons in *The Diseases and Disorders of the Horse*, we spoke of aconite and arsenic poisoning, and mentioned that though arsenical poisoning in horses is diminishing, poisoning by aconite is not at all uncommonly met with, through the administration of overdoses, prescribed by incompetent men. Poisoning of the ox is not so common as in the horse, and, when it does occur in the former animal, it is more often the result of accident than of real ignorance. Ergotism, or poisoning by ergotised grasses, assumes, however, a greater importance as a cause of disease and death in oxen than in horses in our country.

We will, firstly, speak of poisoning by meadow saffron, or autumn crocus (*Colchicum Autumnale*), a plant recognised at once by its beautiful purple flowers and shining dark green leaves. Several cases of poisoning by eating the stalks, leaves, pods, and seeds of this plant have been described; but the writers have never met with an instance in the case of the ox. The symptoms manifested generally are colic, diarrhœa, great straining, dulness, cold extremities, and extreme prostration. The meadow saffron is in full bloom in June and July, and is to be regarded as an active poison, very dangerous to horses and cattle. It has been observed that when oxen have partaken of it in some amount, they experience much discomfort, and, thus learning by experience of its nature, often cease to further partake of it.

Regarding the treatment of colchicum-poisoning, we need scarcely say that the animals should be at once removed from the pasture. If only small quantities have been taken, the animals do not generally suffer after removal. If much has been eaten, the diarrhœa is very severe, the pulse becomes weak and irregular, and symptoms of great prostration supervene. When

the meadow saffron has been eaten, but not largely, mucilage of linseed, with two ounces of spirit of ammonia and four ounces of brandy, may be given every four hours. If the case be not at all severe, three gills of linseed or castor oil will suffice, followed by the ammonia draught, which may be repeated if necessary.

If the animal be not seen until the plant has been eaten some time, it will then be necessary to adopt a somewhat different line of treatment calculated to allay the irritation set up and to stimulate the nerve centres. Mucilage of linseed or thick gruel should be given in large amount. Brandy is as useful a stimulant as any, and it may be given in eight-ounce doses every four hours. If there be much purging, two ounces of tincture of opium may be given with the brandy, and may be repeated at the same intervals. To the belly, cloths wrung out from hot water should be constantly applied in the severe cases, or a smart mustard blister may be employed instead. At the autopsy, the stomachs and the intestines of animals which have died of colchicum-poisoning reveal signs of acute inflammation. The lining membrane is of a bright red hue, and, when touched, easily peels off.

Aconite-poisoning in the ox is not very uncommon. It has been seen by us in the case of a cow quite recently, being due, as it always is, to an overdose of one of the preparations of aconite (the tincture), prescribed, as usual, by ignorant medicine-sellers as a fever medicine. This animal died, but what actual share the overdose of aconite may have had in the cause of the fatal issue we do not say. Aconite-poisoning is seldom fatal; but the symptoms shown are often very alarming. They consist chiefly in sudden difficulty of breathing, gurgling in the throat, trembling, and frothing at the mouth, convulsions, and imperceptible pulse. Horses we have known actually fall to the ground from absolute loss of power to stand; but they seldom actually die, and, when they do, one cannot always eliminate from the case the original source of illness for which the draught was given and repeated too quickly in succession. Two ounces of spirit of ammonia with four ounces of brandy may be given in gruel in these cases, and repeated at intervals of two hours, once or more if necessary.

We now propose to speak of poisoning by the foliage of the yew (*Taxus Baccata*). Although it is believed by some

that the yew is only dangerous when in the dry state, it must be very clearly and emphatically understood that it has not by any means rarely proved productive of death in horses and oxen which have browsed on the fresh green leaves and twigs. There is, however, some uncertainty as to the poisonous action of the yew, for instances are recorded where oxen and horses have apparently eaten with impunity even rather large quantities of the fresh foliage. Yet these exceptional cases are explicable on the supposition either that not sufficient was taken, or that the yew was of a variety different from the ordinary English or Irish kind. Poisoning by the yew has been known to cause a fatal issue in horses and oxen in from two to three hours after ingestion of the foliage, and, indeed, so rapidly does death ensue in severe cases that the symptoms manifested may not be noticed. In most cases, indeed, the signs of yew-poisoning are not by any means distinctive, for they resemble those caused by other narcotic poisons; and one cannot diagnose a case for certain, unless fragments of the foliage of the tree itself are discoverable.

In the general way, an ox which has eaten of yew foliage is found very much prostrated, cold, and shivering; the paunch is often distended; the pulse is weak and fluttering, and soon becomes imperceptible. The poor animal becomes oblivious to its surroundings, at length sinks prostrated, and death rapidly ensues. After death, as a rule, there is an inflamed condition of the lining membrane of the stomach and intestines, but the *post-mortem* signs of yew-poisoning are not characteristic, and are uncertain, unless one finds fragments of the foliage in the stomachs.

In cases of yew-poisoning, four fluid ounces of spirit of ammonia with eight fluid ounces of brandy should be given in a quart of mucilage of linseed; this dose should be repeated in one hour, and again, as deemed necessary, at intervals of two, three, or four hours. In the intervals of giving the draught, mucilage of linseed or oatmeal gruel must be given. A full dose of an active purgative should be administered after the first draught; aloes, in solution, in dose of eight to ten drachms, followed by a quart of linseed oil, is perhaps as good as any. Mustard should be applied externally to the belly. In severe cases the operation of *rumenotomy* has been recommended by Professor Williams, in order to remove the foliage from the paunch.

Of the next poison, black hellebore, we have little to say, because, fortunately, cases in which this irritant has been employed are becoming very much less frequently met with. Even yet, however, in some parts incompetent persons at times use the black hellebore as a counter-irritant dressing for setons in the dew-lap. This practice is most strongly to be discountenanced. In a case of extreme inflammation set up in this manner, the swelling must be fomented, and a full dose of purgative medicine given.

Cases of poisoning by eating the solanum dulcamara, or woody nightshade, a plant which flowers in the months of June and July, and produces berries a few weeks later, are rather uncommonly met with. The symptoms manifested are feeble

FIG. 45.—SOLANUM DULCAMARA.

pulse becoming almost imperceptible, and wildness manifested by a strange look of confusion and dismay, or by mad rushing at random to and fro. The pupils become much dilated, and the bowels very freely opened. Treatment of these cases consists in the administration of stimulating draughts, as in the case of poisoning by the yew; but, if much has been eaten, a fatal issue generally ensues.

We append here a copy of a report by Mr. J. B. Gresswell.

GENTLEMEN, May 31st, 1888.

I have been over to Elsham this day and carefully investigated the outbreak of disease among cattle on the farmstead occupied by Mr. George Fowler.

I found on inquiry that two had died, and that one had been slaughtered by order of the owner. A fourth died while I was there. Two more were affected.

I also found that the cattle had been out at grass for some three weeks or so, and that the owner's father had for the past ten years lost a number of beasts from time to time, all of which, as nearly as could be remembered, manifested similar symptoms.

The owner informed me that his father had in the past employed several veterinary surgeons, but that all remedies had proved unavailing.

The first beast I saw was a two-year-old heifer. It had been brought up from grass on the 30th, and was noticed to be straining. I found the temperature to be 102° F. The pulse numbered 126 per minute, and the beats were feeble, irregular, and intermittent. There was much straining and tenesmus with excessive fluid evacuations.

The next beast, a three-year-old cow was evidently in the last stage of the disorder. The pulse was quite imperceptible. The temperature was 103·2°. She was quite incapable of standing, and moaned and strained heavily. The conjunctival mucous membranes were of a deep brick-red colour, and the pupils widely dilated. Yesterday this cow was so wild and delirious that no one dared to go near her.

The third case I saw was a calf aged ten months. The pulse was rapid and feeble, the temperature 101·5°. The eye-lids were highly injected and the pupils dilated. This animal had been ill for three days, and had strained so violently as to eject about four inches of the rectum.

A fourth beast, a two-year-old heifer, had been killed. The symptoms, as near as I could ascertain, were almost identically similar to those presented by all the others. A careful post-mortem examination revealed the following lesions:—

In the abdomen there were about four pints of peritoneal effusion of a light yellowish tinge. The omentum and mesentery were much swollen, and contained a quantity of light-coloured gelatinous effusion.

The mesenteric glands were slightly enlarged. The contents of the rumen and reticulum had been thoroughly re-masticated. The contents of the omasum were very dry and caked. The mucous lining of the abomasum and along the length of the bowels was of a pinkish hue in patches. The lungs were very slightly congested. Beyond this, the contents of the thorax were quite healthy.

The membranes of the brain were congested. There was slight extravasation of blood in the lateral ventricles of the brain.

When I had finished this post-mortem examination, we found that the second cow was dead. The autopsy was in this instance much similar to the one above named.

My diagnosis of these cases is poisoning by some vegetable which grows in these paddocks: either Solanum dulcamara or Bryonica Dioica. An enormous quantity of this latter grows in the paddocks.

There is a total absence of any symptoms of any infectious or contagious disease.

I am, Gentlemen,
Your obedient servant,
JAMES B. GRESSWELL.

We now pass on to the consideration of one of the most important of all the poisons of the ox and sheep, and with this we conclude our review of the vegetal toxic agents. Ergot, the poison to which we allude, is caused by the growth of a fungoid parasite which infests most of the grasses and cereals. Its

disastrous effects on our cattle and sheep are said to be great, so much so that one wonders that landowners and farmers have as yet made themselves so little acquainted with the results of scientific research into its nature, growth, prevention, and very serious consequences. The cultivated grasses which most often become diseased by the growth of this vegetable fungus are timothy grass, tall fescue, floating sweet grass, fox tail, and rye grass. The weed grasses most generally infested are soft brome grass, couch grass, and wall barley grass. Among the cereals it is especially common in rye and maize. The French word *ergot* signifies a spur, and was given to these peculiar fungoid growths from their assuming a shape not unlike a cock s spur.

Ergot of rye is the name used to designate the parasitic growth infesting the secale cereale, or rye cereal. In those countries where rye bread is much eaten, ergot of rye is often present in large quantities in the flour, and very alarming symptoms and death may result therefrom. In Russia and other countries gangrene, or mortification of the limbs and other parts, has in some seasons especially been very common. At the commencement of last century it is recorded that no fewer than five hundred patients at one time were being treated in the hospital at Orleans, and these cases were entirely the result of ingestion of ergot of rye in the bread. The disease set up was shown by gradually extending mortification of the limbs. Amputation of arms and legs did not in all cases stay its onward progress, ending in death. Ergot of maize is said to be common in Columbia, and to induce shedding of the hoofs in horses and mules, and the laying of eggs without distinct shells by fowls which have fed upon the grain so affected.

Our readers will understand that ergot itself botanically belongs to the fungi, and the rye or other grass on which it is parasitic to the graminaceæ or grasses. Ergot is the sclerotium of the fungus, called claviceps purpurea in the case of the rye grass, in which it is produced between the pales, growing in the ovule, which remains unimpregnated and undeveloped, and thus never becomes a grain of rye or wheat. An ergot grain of any grass is found to be a purplish or bluish-black hard elongated body, easily recognised when once carefully observed. It is dense and compact, and has a peculiar unpleasant odour and mawkish taste. Ergot of rye is generally arched, and

is about one-third of an inch to about an inch and a half in length.

It has been found that ergot is especially common in grasses in damp situations, and is more abundant in wet seasons when the rainfall is very high ; but even when very prevalent in our pastures, it very commonly escapes detection, until its presence is suspected from the animals feeding upon it manifesting signs of serious disease. When affecting our pasture grasses, the ergot is only about a half to a quarter of the size of the ergot of rye, and may even be much less.

If the grasses be very carefully examined towards the end of July, ergot will most likely be found, and it will increase in abundance in the early part of August. As winter approaches, or in late autumn, the ergot falls to the ground, and from it there grow several tiny mushroom-like prolongations, each about an inch long. In the expanded tops of the mushroom-like growths large quantities of spores are developed. These very tiny spores escape, when the grasses are in bloom in June next season, and establish themselves in the grain case, and proceed to develop in the unfertilised ovules, which would otherwise form healthy seeds. The fungus is thus established in the grass, and its growth proceeds apace. When nearly fully matured, the ergot develops a little growth at the end of the spur. This little growth, *conidium*, develops spores, and these escape and invade the remaining healthy grains of the same grass and others in the field or pasture, and thus fresh ergots are produced. These, it will be understood, are secondary ergots.

Now, what is known to be the therapeutic action of ergot, for it is employed as a medicine in human and veterinary practice ? It is known to have a very powerful effect on the uterus, causing its muscle to contract, and this is more especially marked if the animal be pregnant, and still more so if parturition has commenced. It has also other important actions, but with this one we are now especially concerned. It is said that when pregnant cows or ewes have partaken of ergotised grasses, they have an especial tendency to abort. When given in sufficient quantity, this toxic agent doubtless causes abortion in cattle and ewes. There have been attempts made to prove that the serious outbreaks of abortion among cows and ewes are due to ergot ; but while admitting that these factors may predispose animals to

be thus influenced, we must emphatically state that this poison is not in all instances, at any rate, the actual cause of the outbreak and of its continuance.

In order to exterminate the fungus in pastures, our meadow grass should be cut in full bloom, before the ergot has time to reach maturity. The grass is only attacked at full bloom, and if cut then, before the grass seeds ripen, the fungus, which requires a month or so to mature itself, will be prevented from developing further and producing spores. Some will agree with Mr. John Walker's views on this question, and with him will think that at the same time the water grasses which grow on the banks of rivers and in the ditches, ponds, and along the hedges, should be cut down.

Mr. Walker advises that in old pasture fields the grass be grazed down pretty bare in the damp localities where we might expect ergot would find a suitable habitat, and that old coarse grasses in rich feeding pastures should be cut down in the early part of July. Such coarse grasses are very often infested with ergot, as they are not eaten down by the animals. By cutting them in July, the ergot is prevented from arriving at maturity, and the pasture itself is improved. A salt dressing is also recommended on these parts of the pasture. It is recorded that a Shropshire breeder of cattle lost £1,200 in three years from the grasses in his pastures becoming ergotised. We do know that other diseases are liable to be induced in animals by eating ergotised grasses. The disease termed grass-staggers is sometimes produced in horses by feeding on rye grass at a particular stage of its growth. This disease must not be confounded with stomach staggers, a condition caused by acute indigestion.

We must now speak briefly of the mineral poisons of the ox, in this connection mentioning especially arsenic and lead. The ox is sometimes the victim of arsenical poisoning. In some exceptional instances, when arsenical preparations are used for dressing the skin for vermin, a quantity of the poison becomes absorbed, and sets up mischief, manifested by the pulse becoming feeble and rapid, and the breathing much accelerated. There is violent action of the bowels, and blood-stained excreta are often voided, if much arsenic has been absorbed. In other instances arsenic may be taken by the ox accidentally by the mouth.

In one instance, under our notice, on April 19th, a few

years ago, three cows were turned out into a field, where they were supplied with water from a wooden trough, which had been used for dressing wheat with arsenic previous to sowing. The trough had been washed out and filled with water for drinking. One of the cows died on the 22nd, the second on the 23rd, the third on the 24th—*i.e.* two, three, and four days respectively after the ingestion of the poison.

When called on the 24th, we found one of the animals still alive. The pulse was small, weak, and much accelerated, it being 120 per minute. The cow was very restless, occasionally sitting upon her haunches and stamping the ground, at times with first one fore-foot and then the other. At times she rolled over on her side, and moaned. The white of the eyes was much injected; the cow purged violently, and died at 10 P.M. on the same day. The appearances after death from arsenical poisoning as usual were very marked and characteristic. The rumen, or paunch, was full of food, and in places it was inflamed, and covered with a layer of lymph. The second stomach was similarly affected. The third stomach, or manyplies, was full; its folds were highly inflamed and of a deep red hue, approaching to purple and black in some places. The small and large intestines were inflamed, and the small intestines contained much grey mucus. The fourth, or true stomach, was also much inflamed.

In cases of arsenical poisoning, copious quantities of linseed mucilage and gruel should be administered, and the antidote, the hydrated peroxide of iron freshly prepared, should be given in ounce doses at intervals of an hour for three or four times, and then every three hours for a day or so. In the later stages, spirit of ammonia and brandy are to be given as stimulants, to counteract the severe debility. In the first instance, if the purging and pain be very great, tincture of opium may be given in two-ounce doses at intervals of two hours.

Poisoning by the preparations of lead is not uncommon; but we have never met with an instance in the ox. It may occur through the ingestion of painters' refuse carelessly thrown into the pasture. In case a fair amount has been taken, the ox becomes dull and sleepy, and the pulse very weak and perhaps imperceptible, and there is obstinate constipation. After a time the pulse becomes more rapid and more full, while the animal

loses consciousness partially or wholly. In some instances mania sets in, and then death soon puts an end to the sufferings.

In these cases a powerful purgative must be given at once: ten ounces of Epsom salts, ten ounces of Glauber's salts, four drachms of diluted sulphuric acid, with twenty minims of croton oil, may be administered in a sufficiency of gruel. This draught may be repeated in half the amount after the lapse of eight or ten hours. After the first draught is given, mucilage of linseed or gruel should be given in large quantities every hour, and at each alternate administration four drachms of diluted sulphuric acid may be added. Where lead-works are carried on, oxen in the district not uncommonly become the victims of chronic lead poisoning.

With regard to the question of poisoning in relation to sheep, it may be said that the principal seat of inflammation when a sheep is destroyed by reason of acrid poisons, whether the poison be gathered in the field, or wilfully administered, or accidentally swallowed, is the fourth stomach, or abomasus. Lambs which have been taken from their mothers at too early a period may die as a result of feeding upon deleterious plants, such, for example, as the yew, and some of the species of the ranunculus, which, if eaten, cause great suffering. Of the metallic poisons, those which are most frequently fatal are arsenic and that deadly salt of mercury, the perchloride, generally known under the name of corrosive sublimate. It is well to remember in this connection that death may occur in lambs as a result merely of coagulation of milk in the true stomach. This subject we shall refer to again more thoroughly under the heading of diarrhœa.

SECTION II.—DISEASES OF THE CIRCULATORY SYSTEM.

THE CIRCULATORY SYSTEM AND SOME DISEASES CONNECTED THEREWITH.

THE question "What, after all, is life?" is one which will now and again recur to the reflective mind. Nevertheless, think of this momentous question and search into it as much and as deeply as we may, it is well-nigh impossible to find anything

even approaching to a satisfactory *rationale* in regard to all those immense and weighty problems connected with our presence here in this comparatively small portion of the boundless universe, and in regard to the conscious existence of each one of us from day to day, and year to year, and its, at first sight, seemingly abrupt cessation or transformation into something higher when death closes the scenes of our troubles and our trials, of our hopes and of our joys. Nor, as a matter of fact, can Science, the potent enchantress of modern as compared with older civilisations, help us very much, except indeed most vaguely, incompletely, and indirectly.

That the *heart* has been for a long time recognised as one of the essential and central factors of life, needs but little pointing out, as the idea has been embodied in the poetical and fanciful use of the word in all ages and in all nations. "He is a heartless monster," "He has lost his heart," "She is his very heart and soul," are terms of expression which imply that the conception of the heart as one of the chief vital elements is one which is universally believed. This has always been the case in greater or less degree among all peoples. As in the majority of all such conceptions, so in this also there is a great deal of truth; for we find, after the fullest inquiry, that the circulation of the blood into all the various parts of the body, though itself dependent upon intricate impulses of nerve-force which are very difficult to unravel, and are indeed as yet incapable of a complete explanation, is an entirely indispensable necessity for the maintenance of life.

From the *Yorkshire Weekly Post* of January 15th, 1887, we extract the following:—

Shocking Affair.—A shunter on the Great Western Railway, at Landore, was on Monday cut to pieces between an engine and truck. The sight of his mangled body so shocked the station-master, Mr. Thomas, that he fell dead.

Unfortunately this is no uncommon instance wherein we find that the heart is a most susceptible organ.

Very frequently, indeed, we are appalled beyond all measure and bounds to hear of great disasters which have removed large numbers of human beings in the midst of their busy every-day life, and we are thus most forcibly reminded of the dreadfully uncertain nature of the conditions of our vitality. It may be a

shipwreck, or an earthquake, or a fire, or a battle, or an explosion in a mine, or a combination of some of these. Of such calamities, perhaps the panic and deadly struggles at the places of exit which led to the loss of so many lives at the terrible fire which so recently occurred at the Opera Comique, in Paris, is most fresh in men's minds.

Now, how did the unfortunate victims of that horrible and tragic occurrence meet with their piteous fate? We read that some of those who died succumbed to poisoning by monoxide of carbon, the gas which is generated when charcoal or other combustible substance containing carbon is burnt in an atmosphere containing a supply of oxygen insufficient to make it possible that the higher oxide of carbon should be produced in full quantity. Probably the majority were suffocated owing to the want of oxygen, and the presence of a great deal of smoke together with carbonic acid gas and other gases. Finally, a few seemed to have died owing to actual failure of the heart's action, due to shock, and intense terror, and fear of the pain of inevitable death. Probably all escaped the horrible pain of actually being burnt alive, though many were reduced to ashes in the sweeping conflagration which ensued.

Mark: some were so panic-stricken with the vivid reality of a sure, unavoidable, and imminent loss of that life which we all of us cling to, despite all the miseries of living, so maddened with mental agony that in the unimaginable horror of their sudden and startling situation their hearts did literally stand still and motionless; and thus these doomed human beings were plunged, by probably a painless path, from the very height of merry enjoyment, all sparkling with beauty and fashion, and full of the thousand and one thoughts of nineteenth-century enlightenment, into the chasm of the future world; shall we say transported to a height of happiness and bliss, or a depth of maddening and ever-enduring despair? or shall we say, into the sweet sleep of eternal oblivion?

Truly it is a shocking picture, this which is presented to our minds, a vision to make us all think most deeply; and though we can account in some measure for the means whereby so much life ceased to flow on in its even course, though we can in some infinitesimal degree realise what that terror must have been like which was felt by those human beings all decked out in the com-

pleteness of the gaiety and fashion of a city, itself the centre of fashionable life, who can say where their conscious existences—where their souls have gone! Who, in thinking of Life and Death, can realise either the one or the other? Who can picture the unfathomable mysteries presented by this world and its inhabitants? We look around, and on every side and in every distant corner the same huge mysterious uncertainty presents itself, and unless one has the immense power which attaches itself to a faith in the good destiny of mankind, all life looks like a hideous mockery, and the Universe presents the appearance of a gigantic panorama of fraud and phantasms, a fitful and most perplexing image of desperate folly, dreadful strife, and cruel misery, and unmeaning, empty, and fleeting joy.

A man, apparently in the heyday of youth and spirits, rides out on a bicycle soon after a heavy meal, and probably a pipe or two of tobacco. He ascends a rather steep hill, is seen to fall, and is picked up, a lifeless corpse. His heart has stopped, owing to a degree of exertion which it was not powerful enough to withstand. Again, a man is found dead in a railway carriage. What is the cause of death? He had run swiftly to catch the train. His heart was weak, and it could not bear the strain put upon it. Such cases as these are indeed quite common—cases, we mean, in which people have died from stoppage of the heart's action. Indeed, when the heart is weakened with disease, a degree of exertion, which in the general way would not seriously damage the constitution, will kill; whereas, if such strains are avoided, the man or animal, as the case may be, might live for years and years.

Much time and labour are necessary in order to enable one to become conversant with diseases connected with the heart and blood-vessels in every class of animals, and it is of importance that investigation should be conducted in regard to this subject, not only in the case of animals suffering from disease, but also in that of those which are in a state of health. Indeed, the physician does, as a matter of fact, expend an immense amount of care and time in the acquisition of the necessary skill and judgment, and every day that comes probably he will have a great number of patients who suffer from temporary or permanent derangement of these most important organs of the body.

Manifestly it is very different in the case of the lower animals;

and there are but very few men who are thoroughly competent to diagnose the diseases of the heart and so on, even in the case of the horse, where such knowledge is frequently of very great value. Such information is of much less importance in the case of the diseases of the heart in oxen. Nor is it a matter of great practical utility that veterinary surgeons should make themselves acquainted with the diseases and derangements of the circulatory system in cattle. As a rule it would not be found advisable that an ox should be taken in hand for a long course of treatment, in order to cure any of the more dangerous affections of the heart.

These are not so numerous in oxen, sheep, and pigs as they are in the horse, which latter animal, noted and used as it is for activity and speed, needs more strength in its circulatory organs, and is also more liable to suffer from any derangement in this part. The chief disorders attributable to the circulatory system in cattle are:—"Anæmic palpitation," "rupture of the heart," "cyanosis," "carditis," "pericarditis," "the presence of foreign bodies in the heart," "endocarditis," "hypertrophy," and "embolism." "Anæmic palpitation" may occur when the blood is in an attenuated and watery condition. The sounds and murmurs, especially aortic, produced when the blood is in this state are softer and more regular than those which arise from disease of the heart, and they may often be made to cease by a judicious use of tonics.

"Rupture of the heart" is by no means frequent, but it has been noticed in oxen which have undergone severe exertion in ploughing. Mr. George Armatage, who is a well-known writer on cattle diseases, mentions a case in which old-standing disease of the lungs had limited the circulation, and, in consequence of sudden exertion when the ox was drawing a heavy load of turnips up-hill, rupture of the right auricle and pericardium took place, causing, of course, almost instantaneous death.

"Cyanosis," or "Blue Disease," occurs in consequence of imperfect closure of what is called the "foramen ovale" of the fœtus, whereby the venous blood from the right side of the heart mingles with the arterial blood of the left side, giving rise to venous pulse and anæmic palpitation, to a blue tinge in the skin and mucous membranes, and to an emaciated and cold state of the body. Moderate exertion may bring on death, and the progress of the animal being hopeless as a rule, the condition is

only seen in very young animals, since they generally either die or are killed.

The heart is sometimes found outside the body in calves and lambs, which in most such instances die shortly after birth. This position of the heart outside the chest in front, at the bottom of the neck, or even beneath the abdomen, is spoken of as "ectopia cordis."

"Carditis," or inflammation of the heart, may be an accompaniment of either endocarditis or pericarditis. The muscular substance of the heart itself is sometimes inflamed near a deposit or seat of injury. Of course this disease is of the very gravest kind, and most generally leads to a fatal issue.

"Pericarditis," or inflammation of what is called the "pericardium," or "heart-bag," may occur independently, or in connection with rheumatism, or with contagious pleuro-pneumonia. Very careful treatment is required to combat this disease, whatever its origin may have been, and death may occur within about two days.

The presence of foreign bodies in the heart is not so uncommon as might be supposed. Both oxen and sheep frequently swallow pins, needles, nails, and such like things, and, as might be expected, these are liable to perforate the walls of the alimentary canal, and pierce through the tissues to the heart, as a result of the movements of digestion, respiration, and circulation. Pigs, too, sometimes swallow such things in their food. Death generally results, owing to pericarditis being set up, or possibly to some other more violent cause. Occasionally an animal lives for some time with these injuries.

The late Mr. D. Gresswell was years ago asked by Dr. Banks to see an ox. It was clear that some cause was seriously impeding the heart's action, probably a needle, or something like a needle. After a careful examination of the animal, he diagnosed the presence of a bodkin, needle, or some such foreign body in the chest, and that the heart at each systole was striking against the blunt point of the needle. He advised that the animal should be slaughtered, and the needle was then found lying in a stained fistulous track, which extended from the rumen through the pericardium to the heart. The heart itself was found to be riddled with holes in the place where the needle impinged upon it, as it moved to and fro.

"Endocarditis" is the name given to inflammation of the lining membrane of the cavities of the heart. It occurs principally as a complication of rheumatic disease, and requires very careful treatment. If allowed to go on unchecked, large growths may be formed in the cavities, and sudden death may occur. The best plan is, in most cases of endocarditis, to make the animal ready for slaughter, and to consign it into the butcher's hands at a suitable opportunity.

"Hypertrophy," or excessive growth of the muscle of the heart, is not common in cattle, though it is rather frequent among horses, and especially in racers.

"Embolism" is a name given to the lodging of a foreign body, *e.g.* a clot of fibrin in any of the vessels. The foreign body thus lodged is called an "Embolus." The iliac arteries are most generally the seat of embolism.

We have now briefly mentioned the more important disorders of the circulatory system, and we may say, in conclusion, that it is a most difficult matter to detect the nature of some of them. Indeed, it requires very special skill, even in the case of the human being, to diagnose the exact character of the disturbance, and the meaning of the various murmurs and other physical signs by which the presence of disease is manifested. In the case of oxen, not only is it of far less importance to be able to ascertain what is wrong with the circulatory system, but it is also very much more difficult. The information at hand is of the scantiest, and it is not at all easy to acquire an exact acquaintance with the varied and complex conditions which may occur. It is only lately that such instruments as the stethoscope and the sphygmograph have been applied in veterinary practice.

Moreover, the tendency of research will take the direction of subjects which are of far greater importance to the community. At the present time the whole scientific world is, as it were, convulsed with the wonderful revelations which have recently been made by the discovery of the intimate connections existing between micro-organisms and disease; and it is well that this is the case, for it would be impossible to over-rate the almost infinite importance of the modern achievement of science which is known as the germ theory.

From what we have said above, it will be clear that oxen are

liable to many afflictions of the heart in all respects similar to those which attack mankind.

SECTION III.—DISEASES OF THE RESPIRATORY SYSTEM.

THE derangements which may affect the respiratory system of any class of animals are of numerous kinds, and manifestly of very great importance. Many of them are essentially amenable to judicious management, but they require to be attended to as well and as thoroughly as possible. If taken in hand at once, many of these disorders we are considering can be checked, and the patients thereby enabled to overcome the serious difficulties from which they are temporarily suffering, and then start afresh once more with a new lease of life. On the other hand, if not stopped, the disease will soon lead on to death. In dealing with any one system of organs, one must bear in mind that all the different functions of the animal body are very intimately connected. As an instance of this, we may mention that the three processes of digestion, circulation, and respiration are necessarily bound up together, and are at the same time all dependent in the highest degree on the working of the nervous system. After a full meal, no animal should be put to any severe exertion, until digestion has made headway. This rule is very applicable in the case of the ox, since in that animal the digestion of the food is a long operation. It is also equally important in ourselves; and not only should we remember that physical activity will retard the process of digestion, but we should also note that mental exertion is a most serious hindrance to that important operation of the digestive organs.

During this process there is a large flow of blood to those organs; and, moreover, the movements of the diaphragm are impeded, whereby respiration is rendered difficult. This, however, does facilitate the regurgitation which takes place during the chewing of the cud. Leaving this subject of the connection of the different functions, it is to be noted that in the case of the full-grown ox the number of respirations per minute is about 16½, whereas in the young animal it is about 19. The respiratory movements are frequent, but not deep. The diseases of the

respiratory as also those of the circulatory organs are not so general among oxen as among horses. Again, the lungs of an ox are practically smaller than those of a horse. This is what might be expected; for the latter animal displays a great deal more of activity and exertion. The horse is very often pushed to extremes, is sometimes kept in hot and close stables, and subjected to sudden changes of temperature and draughts. Oxen, especially those used for working, are also sometimes badly treated; but they are not as a rule overworked, nor are they pampered. Cattle, especially when fat, are occasionally liable to be overdriven. Dairy cows and beasts which are being fattened are far too frequently subjected to a foul atmosphere, which is sure to bring disease sooner or later.

The name "auscultation" is given to the process of listening, by means of the ear applied to the surface of an animal, to the sounds made in the functions of breathing, and those of the heart, and so on. It is more valuable as an aid to diognosis in the case of the lungs and air passages than in that of the circulatory organs in oxen. If the animal is ordinarily clean and free from lice, the ear may be applied directly to the walls of the chest, and thus the sounds which are made by the movements of breathing are heard without any intermediate appliances. In case of need, a handkerchief or towel may be placed on the surface of the part to be examined. The stethoscope is an instrument specially designed to aid the hearing of sounds produced within the body. The one most generally employed consists of a long tube provided with a conical extremity, formed so as to collect and concentrate the sounds, and with a flattened ear-piece. The ordinary sounds which are heard in the case of a healthy animal are interfered with, if there are tumours or other obstructions in the nasal chambers, or if the mucous membrane of those chambers is diseased. If the mucous membrane of the larynx is thickened, roaring and whistling may be produced. There is, too, a peculiar kind of lowing which is a sign indicative of pain, and this may interfere with auscultation. The vesicular sound observed during health may be variously altered, enfeebled, absent, or replaced by some other sound. If it be wanting, and if over the corresponding part there be dulness on percussion, it is probable that the lung is solidified or replaced by fluid. If there be gurgling, bubbling,

hissing, or crepitant sounds, it is probable that inflammatory or dropsical fluid is in the bronchial tubes or the pulmonary vesicles. If there be rubbing sounds, there is probably inflammation in, without exudation between, the opposite pleuræ, and, *mutatis mutandis*, the same rules hold in regard to the opposite layers of the pericardium. In cases of pleurisy and pleuro-pneumonia, if the intercostal spaces are pressed, flinching and other signs of pain are manifested.

CATARRH.

Catarrh, or cold, or flux from the nostrils, is by many persons often looked upon as merely a cold ; but it should, never-

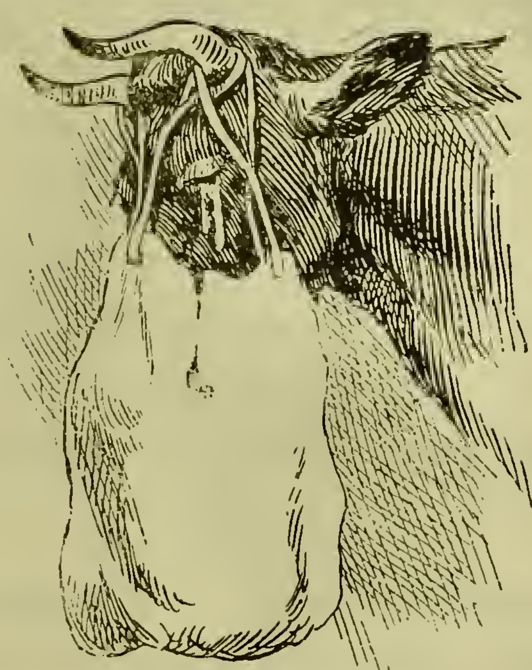


FIGURE 46.
Method of steaming the Nostrils in a case of simple Catarrh.

theless, be very carefully looked after. It is due to congestion or to inflammation of the Schneiderian membrane, *i.e.* the lining membrane of the nose, that of the nasal sinuses, and of the pharynx and larynx being also in a certain measure involved. The disorder is most frequent in spring, when east winds prevail, and when animals are often exposed to extremes of wet and cold, after having been kept under shelter. It may arise from dampness or draughts, and is especially liable to attack oxen which are debilitated by reason of previous disease. It is usually ushered in by rigors, by passage of mucus from the nostrils,

stiffness of gait, dulness, and slight fever. According to some writers, it may assume an epizoötic form. The Schneiderian membrane is red and swollen, at first dry, but soon gives a watery discharge which becomes of a thick mucous character, and afterwards muco-purulent. The patient coughs and sneezes, and a profuse mucous discharge from the eyes may set in. Place the animal in a well-ventilated shed, and steam the nostrils by

FIGURE 47.

Another method of application of steam to the nostrils in a case of simple Catarrh. (After *Armatage.*)

means of an antiseptic inhalation. A medium dose of Epsom salts, together with a diffusible stimulant, may be administered, and the animal should be carefully attended to.

EPISTAXIS.

Epistaxis, or bleeding from the nostrils, sometimes occurs as a symptom of serious blood disorders in which ulceration or rupture of blood-vessels of the Schneiderian membrane has taken place. In the case of working oxen this bleeding of the nose may come on from exposure to the heat of the sun, which has brought on congestion and rupture of the blood-vessels. Again, it may be brought on by an injury. Cold-water and styptic applications or plugging of the nostrils may be necessary. The bleeding may come on from polypus in the nasal chamber, which may be removed by means of a ligature, or by the help of that valuable instrument called the écraseur. Moreover,

leeches have been known to gain access to the nasal chamber, when the horse is engaged in drinking stagnant water. These creatures bring on a great deal of bleeding. They may be removed by the process of sneezing, or by the injection of a solution of salt.

LARYNGITIS.

Laryngitis, or sore throat, or inflammation of the larynx, may come on after, or accompany, catarrh or bronchitis, or be a primary affection. The pulse is hard, the throat is swollen, and the muzzle protruded. If the throat be pressed, great pain

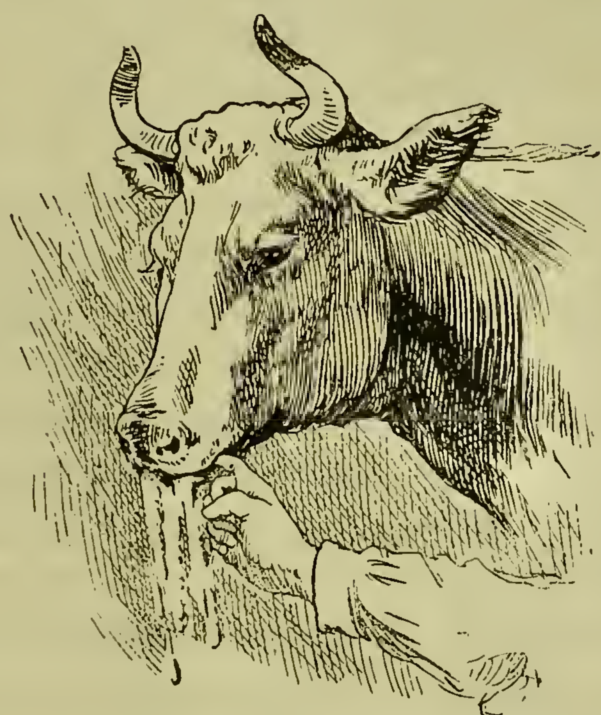


FIGURE 48.

The above picture represents the appearance presented by a beast suffering from Laryngitis, or sore throat. (After *Armatage.*)

is caused, and a dry, hard cough may be produced in that way, or, indeed, occur occasionally as a result of the disease itself. From the mouth there is a profuse discharge of saliva, and pain and difficulty are experienced when the animal swallows. The animal breathes with difficulty and loses strength rapidly, and in fatal cases death results from spasm of the larynx, extension of inflammation, or other causes. The veterinary surgeon in attendance will decide if tracheotomy should be performed, and if so will proceed to carry it out. The throat should be fomented, and the animal should be made to inhale steam to which some antiseptic has been added. Nutrient or other medicated enemas

may be administered, but it is well to avoid giving drenches. When the malady is subsiding, a stimulating application, such as the liniment of cantharides, may be applied to the throat. Tumours of the larynx, though not frequent in the ox, are very serious impediments to the function of breathing. Moreover, there may be tumours of adjacent parts, or other complications which interfere with respiration.

BRONCHITIS.

Bronchitis, or inflammation of the lining membrane of the bronchial tubes and trachea. This disease is rather frequent in the ox, being generally brought on by exposure, or such mechanical causes as the entry of solid or liquid particles into the air passages or the presence of parasites in the lungs. In oxen afflicted with bronchitis the pulse is hard at first, the respirations are greatly increased in number, the cough is frequent and distressing. Those mucous membranes which can be seen present a purple hue, owing to a want of oxidation, and there is much debility. There is a profuse discharge from the nostrils, which is at first watery, and at a later date becomes of a thick consistence. Death may come on from suffocation, owing to blocking of the air-passages or possibly to extension of the inflammation to the pleura.

In cases of bronchitis it is very important to keep up the strength of the animal, to attend carefully to every want, and to allow a free supply of pure air. Steaming should be resorted to, and the steam should be impregnated with some suitable antiseptic. Stimulating applications should be applied to the sides of the chest and to the trachea. If the bowels are constipated, they should be freely opened, and the action of the heart should be maintained, if it be thought necessary to do so, by means of the administration of stimulants, and enemas may be given. At a later time it is advisable to administer diffusible stimulants, together with vegetable tonics, and to allow a liberal diet.

Chronic bronchitis frequently occurs in oxen, and there is in these cases a persistent hacking cough, general weakness, a tendency to slight febrile attacks, emaciation, and inability to undergo exertion. This disorder may be associated with asthma, emphysema, and consolidation of portions of the lung. In

many cases, though tonics, quiet, and easily-digestible food will do a great deal of good, slaughter is the best course.

Parasitical bronchitis, or Hoose, or Husk, frequently occurs in calves under a year old, and causes among them a considerable mortality. It is owing to a worm known as the *Strongylus micrurus*, which is found also in the alimentary canal and in the heart and blood-vessels. In wet seasons this affection breaks out, especially on low, badly-drained lands which are liable to be flooded. It occurs particularly among calves which have been kept out late in the autumn, and as a result of feeding on land on which animals suffering from the disease have been previously grazing. The cough is very forcible, and has a special hacking character; and it causes the expulsion of stringy mucus, in which parasites or their ova may be seen with a low power of the microscope, or very likely with the unaided eye. The animals become emaciated, and there may be diarrhœa. The worms are present in the bronchial tubes and air-passages, and hence they seriously impede the process of respiration. Animals which are severely affected should be placed in comfortable quarters, and the bedding materials on which the discharges fall should at frequent intervals be destroyed. Those which are but slightly affected should be taken away and placed on high and dry pastures. The water supply should be pure, and rock salt should be supplied.

With regard to direct treatment, we cannot say much here. Fumigation with the gas given off from burning sulphur and iodine has been strongly recommended; but, as Mr. John Henry Steel appositely points out, the parasites can sometimes withstand a more severe dose of such agents than the calves can, and hence great caution is needed in the employment of them.

Acute pulmonary congestion occasionally occurs in the ox as a result of over-driving and over-work. It is manifested by extreme difficulty in breathing, by profuse cold sweats, coldness of the extremities, very rapid and almost imperceptible pulse, rapid respirations, and sometimes a mucous discharge containing a little blood flows from the nostrils. The patient lies down, coughs frequently, and has a wild look.

Hæmoptysis, or bleeding from the lungs, may be due to several causes. The flow of blood may be profuse, and the blood varies in colour. It may be mixed with mucus, and it

flows through the nose and mouth. It may be a result of acute pulmonary congestion, of laceration of the lung-tissue, or of certain specific disorders such as give rise to ulceration of the lungs or cause congestion. For example, hæmoptysis may be due to tuberculosis.

PNEUMONIA AND PLEURISY.

Pneumonia, or inflammation of the lungs, is not a common disease in oxen; but it is much more frequently met with co-existing with pleurisy, or inflammation of the lining membrane of the chest and lungs. Our readers will recollect that we have already spoken at full length of the infectious disease termed pleuro-pneumonia, a malady which is one of the most deadly of the bovine scourges; we now have, however, to discuss only

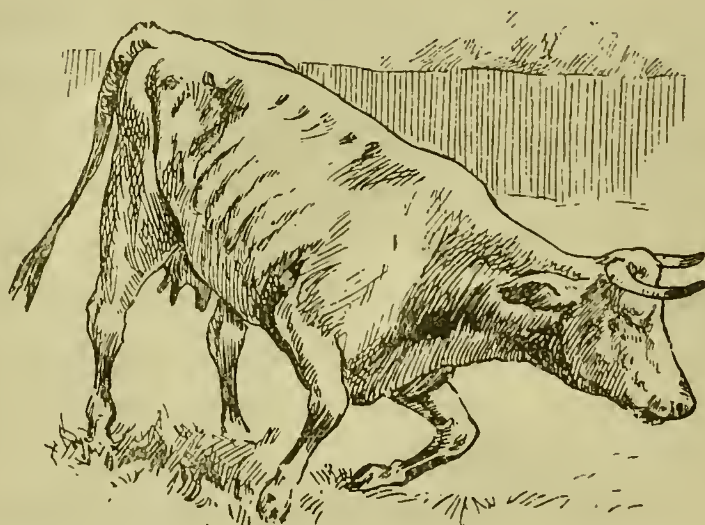


Fig. 49.—Last Stage of Sporadic Pneumonia.

the simple and non-infectious inflammations of the breathing organs, for the most part we may say dependent upon cold, damp, or chill, for their immediate causation.

Cases of simple inflammation of the lungs are, as might be expected, more commonly seen in working oxen than in feeding beasts. The onset of the disease, which is not difficult of detection, is, as a rule, sudden, and not uncommonly characterised by shivering fits. We have already stated that an ox in health breathes about twelve to eighteen times a minute, and the pulse numbers from forty to fifty per minute. It is a little odd that those who have most to do with oxen seldom or never acquire the knowledge where to take the pulse, although one often finds that horse-owners are well acquainted with the way

in which it may be felt in the animals under their charge. It will be remembered that the pulse in the horse beats thirty-six times to the minute, and his respirations are nine to twelve during the same time. The horse breathes less rapidly than the ox, but the lungs of the horse are relatively more capacious; the pulse is likewise less rapid in the horse than in the ox. It has indeed been shown that the pulse and respirations bear a definite relation to each other in health, whereas in disease the relationship may become much altered. The temperature in the horse is on the average 100°·5; whereas in the ox it is higher, varying from 101°·5 to 102°·5, in health. The highest temperature we have ever seen in the horse was 109°; and this was in a case of acute tuberculosis (consumption), so very rarely seen in this animal. In man, although the pulse (seventy-two on the average) and the number of respirations (eighteen on the average) are more rapid than in the ox and horse, yet the temperature is lower (98°·4) in the human race.

In order to take the pulse of an ox, one should pass the arm round the animal's head, and lay the fingers on the lower portion of the lower jaw, at about its middle point, and then, if one feels carefully, the little artery will be found, and its beating will be distinctly felt. The pulse may be taken on the same spot in one's self, though in this situation it is not so distinct as at the wrist. It is best to approach the near side of the cow, and to place the right arm over the neck, while the left hand holds one of the horns.

In inflammation of the lungs, the number of respirations are increased, and may reach as high as 40 to 70 per minute; while the pulse, which is full and bounding, may reach 70 to 100 beats.

The temperature is raised several degrees, and febrile symptoms become very marked. The skin is dry, parched, and hot, and thirst is marked. As a rule the poor animal sinks to the ground, in this respect differing from the horse, which, as a rule, in all pulmonary affections remains standing. In milch-cows the secretion of milk is stopped at the outset of the disease. If one listens with the ear applied to the side of the chest, one will find that the usual breathing murmur, heard so distinctly in health, has vanished, and is replaced by harsh, loud breathing, somewhat resembling that heard when the ear is applied over

the trachea of a healthy animal. Cough is generally present, though in some instances it is not marked. The animal looks anxious, and the head and neck are protruded, the bowels are constipated, while the water passed is scanty and high-coloured.

As the disease progresses, the pulse becomes feeble and more rapid, the breathing still more accelerated. The cough, not often frequent, becomes of a weak character, and blood-stained expectoration may be thrown up. In many instances the disease takes a favourable course, and the animal becomes convalescent in about a fortnight from the onset of the attack. In others, death occurs from consolidation or from mortification of the lungs, from the fifth to the tenth or fourteenth day. It is customary to bleed in cases of acute inflammation of the lungs, though aconite, in the form of tincture, often acts as efficaciously as the more direct method of controlling the inflammatory action. Of course it would not be admissible to administer aconite, if it were intended to slaughter the animal for food in case of an impending fatal issue.

In the first place, in this affection the animal should be placed in a well-ventilated airy box or shed, and under no circumstances should he remain in a close, stuffy stall, seeing that a due supply of fresh, cool air is of paramount importance in enabling the animal to cope with the increasing difficulty in breathing. Around the chest, cloths wrung out from hot water should be kept constantly applied, and should be renewed every hour, so long as the acute symptoms last. Afterwards, the sides of the chest may be blistered by the application on one side of mustard and on the other, if it be also affected, of ointment of cantharides, or a strong ammonia and turpentine liniment. In the first instance a fair dose of Epsom salts should be administered in a pint of warm water, and every four hours there should be given a drench of solution of carbonate of ammonium, of solution of acetate of ammonium, and camphor. Digitalis is also sometimes useful. Where bleeding is not practised, and in very plethoric cases where it is carried into execution, the pharmacopœial tincture of aconite in forty-five-minim doses is most useful. When the lungs are extensively inflamed, it is customary to slaughter, except in the case of valuable breeding animals, or where the ox is too poor to be of much value as food.

By pleurisy we understand an inflammation of the serous lining of the chest walls and of the serous lining of the lungs themselves. This lining membrane is termed the pleura. Pleurisy seldom occurs alone in the ox, for it is nearly always accompanied by inflammation of the lungs in greater or less degree.

Inflammation of the lining of the chest is in most cases due to cold and damp, but it may result from injury, and not

Fig. 50.—Acute Pleurisy.
This picture represents an ox suffering from acute pleurisy.

uncommonly it, with pulmonary collapse, is a complication of cases of acute rheumatism, as may also be the case in man. (See remarks on Felon.)

The disease sets in with the manifestation of febrile symptoms, the pulse is felt to be small in calibre but firm in character, and in number it reaches sixty to seventy per minute. The breathing in animals suffering from pleurisy is characteristic. The chest walls move but little, the inspirations are shallow and short, while the expirations are accomplished with greater ease, and are more prolonged.

The whole chest is kept, as it were, fixed, and the walls of the belly are observed to move more in breathing; in this way the animal compensates for the shallow motions of the chest walls. The sides of the chest are very tender to the touch, and the animal manifests great pain, if he be pressed upon between the ribs. If the ear be applied to the affected side, or sides, for

both may be simultaneously inflamed, the usual respiratory murmur may be heard, and in addition a loud sound, as of leather creaking and rubbing. This sound is due to the roughened lining of the chest walls rubbing against the roughened lining of the lungs themselves, and in healthy animals it is not heard, for the moist, smooth, glistening membranes then glide noiselessly on one another, as air is taken in and given out from the lungs. Anxiety and dejection are depicted on the countenance, and the eyes are half shut. In cases of pleurisy, there is generally a short, painful, hacking cough, which is restrained by the animal as much as possible. The appetite is diminished or lost, and rumination is not performed. The animal generally lies down upon the sternum, so as to fix the chest-walls as much as possible, and so reduce to a minimum the thoracic respirations. When the animal is standing, the head droops, and the ears hang downwards. When the pleurisy is a complication of rheumatism, the pain in the chest is commonly more severe, and the tenderness even more acute, owing to coincident pericarditis.

In many cases of pleurisy the inflammation gradually subsides, and the animal makes a recovery, though not rapidly. In other cases the inflamed serous membranes pour out a quantity of fluid which accumulates between the chest walls and the lungs. This presence of water in the chest, which is termed pleuritic effusion, is of great importance. As it comes on, the acute symptoms of pleurisy abate, and the friction sounds cease then to be heard, though, when the fluid is afterwards absorbed, they may again become distinct. Respiration, when there is pleural effusion, becomes less painful, and it is deeper than in the early stage of pleurisy. Indeed, when effusion occurs, the animal even manifests signs of improvement for a time; but ere long dropsy sets in, the legs, chest, and belly become swollen owing to accumulation of fluid in the layers beneath the skin, the breathing becomes laboured, the pulse, wiry and rapid at the onset of the disease, becomes soft and frequent, and, as the effusion increases, it becomes irregular, feeble, and even imperceptible. The breathing becomes still more embarrassed now, the inspiration is prolonged and it is jerky and irregular, and the expiration act is performed with difficulty. If one listens to the sides of the chest, one cannot hear the respiratory murmur over the lower portions of the chest, owing to the presence of

fluid. If the disease proceeds, the animal becomes worse, and greatly debilitated. The surface of the body becomes cold, and the pulse-beat imperceptible, until at length the animal sinks and dies.

In many cases under our notice as much as six to seven

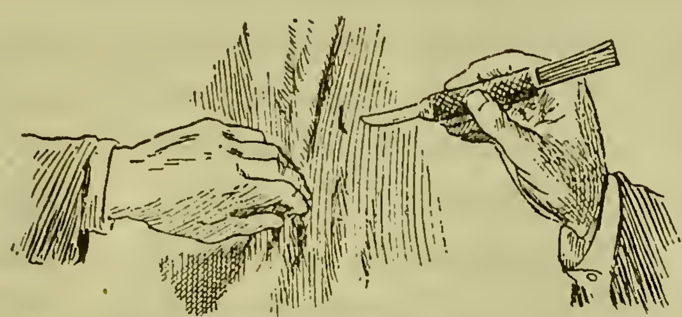


Fig. 51.

The above illustration shows the method of drawing the skin into folds previous to making the primary incision for paracentesis thoracis, in a case of hydrothorax.

Fig. 52.—The Trochar and its Outer Case, the Canula.

This instrument is used both in cases of tympanitis and in those of hydrothorax and pleuritic effusion.

Fig. 53.

In the above picture the fluid is seen to be flowing from the chest by means of a canula. The vessel is used for collecting the fluid and pouring it into a pail or bucket.

gallons of fluid have been effused into the chest in the course of a few days.

After giving a laxative, we usually recommend drenches of acetate of ammonium, camphor, and nitric ether every four

hours, with the addition of aconite in acute cases in vigorous animals. We do not recommend bleeding in cases of pleurisy. In the acute stages hot cloths should be applied, as in inflammation of the lungs; and as the acute symptoms subside, mustard poultices or blisters of cantharides ointment should be assiduously made use of.

Should effusion of fluid appear imminent, it is very essential to administer stimulating medicines, with digitalis in the form of powder or tincture. We especially recommend a combination of carbonate of ammonium, iodide of potassium, and digitalis in doses of about one drachm. In all cases of pleurisy, after the acute stage is over, stimulants are indicated, and the carbonate of ammonium is one of the most valuable. When the animal shows signs of improvement, and the effusion is being absorbed, tonic treatment is indicated. The tincture of the perchloride of iron, with nux vomica, is very useful indeed. Generous diet is required after the acute stage of pleurisy.

If the effusion of fluid be abundant, it is necessary to tap the chest. This operation is termed "paracentesis thoracis." It is performed by passing a large-sized Southey's trochar and canula through the wall of the chest at its lower portion, between the eighth and ninth ribs. The trochar is then withdrawn, while over the external orifice of the canula is passed one end of a piece of india-rubber tubing, the other end of which dips to the bottom of a vessel placed to remove the fluid as it flows out from the chest.

DISEASES OF THE RESPIRATORY SYSTEM IN SHEEP.

We cannot give very much attention to the disorders of the respiratory mechanism in sheep, nor, indeed, to those of the circulatory system of this animal, for the simple reasons that both these kinds of derangements in the sheep are neither very well known nor of very great importance. In horses these two groups are of exceptional interest and moment; but, as for sheep, they are most liable to derangements of the digestive organs. The number of respirations per minute in the case of the sheep is very variable, and, indeed, may be as few as thirty or as many as two hundred, in accordance with different conditions—as, for instance, of work or of rest, of climate or

weather—and we should always remember that much greater importance is to be attached to the character of the respiratory movements than to the actual number of them.

The first disease of the respiratory system which we have to consider is that to which the name of strangles has been given. However, it is but very rarely that the disease resembling strangles of the horse and strangullion of cattle does affect sheep, making its appearance more particularly among hoggets. When a sheep is afflicted with this malady, a swelling may be seen under and between the jaws. At first it is hard, but it gradually enlarges, and becomes soft, owing to the formation of matter inside it. The swelling is hot and tender, and the sheep loses appetite, and coughs, and rapidly becomes weak. As soon as the tumour points, it should be lanced. If the wound which results gives out an offensive smell, it should be washed out with a solution of chloride of lime or some other effectual antiseptic such as the lotion of carbolic acid : and at the same time about three ounces of Epsom salts mixed with a small quantity, say half-a-teaspoonful or so, of ginger may be given. Small doses of about a teaspoonful of ginger and the same quantity of gentian may be administered daily for a few days.

Catarrh.

Sheep suffering from catarrh give forth a discharge from the nostrils. The white parts of the eye are red, there may be a profuse discharge of tears, and the animals cough, and lose their appetites. In some cases it may be found advisable to abstract a little blood, to give an opening drench (for instance, about three ounces of Epsom salts), and to transfer the sheep to some dry and sheltered place.

Laryngitis and Tracheitis.

When the upper part of the air-tube called the larynx and trachea is inflamed, a sheep thus afflicted may often be seen to stretch forward its head, as if with the object of breathing with greater freedom, and may then give utterance to a ringing cough causing great pain. If the symptoms are of an urgent description, it may be found advisable in the first instance to abstract blood, and to administer aperients. The animal should be removed to a suitable sheltered spot.

Bronchitis, Verminous Bronchitis, and Pneumonia.

The term "catarrh" being applied to a slight cold due to inflammation of the topmost part of the respiratory apparatus, and the term "laryngitis" being applied to inflammation of the larynx, the term bronchitis similarly implies that the mucous membrane of the bronchi or air-tubes is inflamed. It is at times very difficult to absolutely demarcate off the three disorders known as catarrh, laryngitis, and bronchitis, respectively, and the same animal may perhaps suffer first from catarrh, then from laryngitis, and finally from bronchitis. Now, the cough of a sheep suffering from this latter complaint has a wheezing character quite different from the metallic and ringing sounds so characteristic of laryngitis.

Again, *verminous bronchitis* is due to the presence of worms in the air-tubes.

The *Strongylus micrurus*, which is the cause of this disorder, verminous bronchitis, has a round and winged head, and its mouth is also round and provided with three papillæ. This Nematode worm is filiform, *i.e.* thread-like, and the tail of the male *Strongylus micrurus* of the calf is smaller than is that of the male of the same parasite found in the sheep. The ovary is situated a little behind the centre. The mode of reproduction is ovoviviparous, *i.e.* the young are born alive, although they are enclosed in an envelope. The males are 1½ in. long, the females rather less than 2 in. This worm is found infesting the bronchial tubes of the ox, the horse, occasionally those of the ass, and it is most commonly met with in the bronchial tubes in the case of calves and sheep; in which animals it gives rise to parasitic bronchitis or husk. One female may give rise to the production of 100,000 eggs.

When grazing, calves and sheep get the larvæ on their noses, and from this situation they pass to the trachea and bronchial tubes. It is possible that the common earthworm has something to do with the origin of husk. Cattle and sheep suffering from this complaint breathe in a laboured manner, have paroxysms of coughing, and foam at the mouth. They refuse both food and drink, and heave at the flanks. Their tongues are black and hard, and they suffer from constipation rather than from

diarrhœa. Lambs, however, are also troubled with scouring at the same time.

Two other varieties of strongylus, viz. the *Strongylus filaria* and the *Strongylus rufescens* are also at times found present in the lungs of sheep. The first of these, the *Strongylus filaria*, has its head provided with papillæ, the mouth circular, and the skin covered with warty papillæ. The *Strongylus rufescens* has its head unarmed. The mouth is furnished with lips, and the œsophagus is short. The eggs are but few in number. The males are about five or six inches long, the females about six or seven inches. These strongyles are generally found together with numbers of the *Strongylus filaria.* Only a few of them have ever been found in one sheep, and they are seen to be coiled up in the substance of the lung. In order to prevent husk, salt should be strewed all over the pastures, in order that the larvæ may be killed.

As a curative medicine, the following mixture may be made :—Pulv. Scillæ, 5 gr. ; Pulv. Ipecac., 1 dr. ; Resinæ Ammoniaci, $1\frac{1}{2}$ dr. This powder may be administered twice daily, or the following mixture may be tried :—Tincturæ Benzoini, 2 fluid dr. ; Balsam of Peru, $\frac{1}{2}$ fluid dr. Mix the two with mucilage. Turpentine has also been recommended.

We may here state that two authorities, Mr. Youatt and Mr. Mayer, recommended by way of treatment of this malady the daily administration of two ounces of salt at one part of the day, and that of about seven fluid ounces of lime-water at some other time during the same day.

Acute inflammation of the lungs may be brought on in sheep by the influence of cold and wet, as a result of chills after hard driving, of careless or injudicious washing of sheep before shearing, of shearing during tempestuous or inclement weather, and other causes of a like nature. At the outset, the patient exhibits febrile symptoms, has a quick and hard pulse (which may become oppressed and intermittent), manifests a dislike for food, ceases to chew the cud, is unwilling to move, heaves slightly in the flanks, frequently gives utterance to a cough (which is very distressing, and which, as the disease progresses, becomes still more quick and painful), breathes irregularly, completely loses all appetite, discharges an offensive and fetid matter from the nostrils, grinds the teeth, is exceedingly thirsty,

darts as if by a natural instinct at food offered to it but retains it in the mouth unmasticated, as if it were unaware even of its presence therein, or rather perhaps as if the necessary energy required for eating were not forthcoming. At length the pulse becomes well-nigh imperceptible, the cough weaker and more painful, the flanks are convulsively agitated, the animal staggers if it attempts to walk onwards, the eyes become clouded, the look of the animal's face is expressive of great distress, the cough ceases, unconsciousness comes on, and at length death closes the scene.

If an examination be then made, the lungs are seen to be black and engorged with blood, of much larger size than would be the case in a healthy animal, and more or less actually decomposed. Very frequently, also, all the viscera may be seen to be in greater or less degree congested, and the liver also is enlarged and softened. If the sheep are seen in the very earliest stage, they should be bled and purged; but such measures would be most detrimental after exhaustion has supervened. In this case, spirit of nitrous ether and brandy in suitable doses are indicated.

Tuberculosis.

So little is generally heard of this disease as afflicting sheep that our readers may be at first sight disposed to ask—" Why, who ever heard of a sheep suffering from consumption ? " Yet, all the same, this animal is very liable to be contaminated with the germs of tuberculosis; and the only reason why the disease, in so far as sheep are concerned, does not attract greater attention than it does, is because these animals are usually consigned to the shambles at such an early age that the disease has not had time to establish itself in a marked degree. A brief consideration of this disease will complete our short review of the disorders of the respiratory mechanism in sheep.

As our readers know, tuberculosis is scientifically classed under the heading of germ diseases, since it is due to the presence of the tubercle-bacilli in the blood, tissues, and organs; but we need not enter into the discussion of the life-history of these particular vegetal germs in this connection. The symptoms are somewhat as follows:—A sheep, although feeding well, may be observed to cough, and, generally speaking, there is

little or no difficulty in getting the animal into fair condition for slaughter. After death, the meat looks well; but if the lungs are examined they are found to be mottled upon the surface, and if we cut into them, we may find many concretions of minute size which in reality are tubercles. The fact is, however, that in the general way, in regard to sheep, tuberculosis is not a disease of very much moment; for, these animals being sent to market sometimes when only eighteen months old, and seldom at a later age than that of thirty months, the malady has not time to work very great mischief in them. If, however, sheep afflicted with this disease were kept alive, so that the disease could mature itself, they would suffer grievously. The afflicted ram or ewe at three or four years of age continues to cough, has pallid lips, loses flesh, and suffers from diarrhœa, which returns again and again, until at last it wears the animal out. This disease is especially prevalent among sheep which are kept on low and moist pastures.

If the disease is recognised, it is best to fatten the sheep, and send it straightway to the butcher. If this course is not taken, the affected sheep should be placed on a dry and wholesome pasture, and salt should be put within its reach. Foreign sheep imported into England from a torrid climate seldom live two years, but die of tubercular affection of the lungs.

We do not propose to devote any more attention to the diseases of the respiratory system in sheep. It only seems necessary to add that the chief concern of the practical farmer in this connection is to take due care of his sheep. If this applies at all times, how much more so is it of the greatest importance in inclement weather, and during the season of lambing! It is very gratifying indeed to observe that the custom of extemporising little sheds by means of straw-stuffed hurdles or sheep-trays is much more general than it used to be, and there is no doubt that a little of this kind of help is of the greatest value to the ewes at this important period of their lives. We should like to see still more advance in this direction, and though we do not say that 'the good shepherd should in these days actually give his life for his sheep,' we do maintain that many of the kindly shepherds of England do help that patient creature very much indeed, and that the tender care and solicitude for their charges which they oftentimes display—

it may be on a cold winter's night, when the snowstorm rages around them—reflect the greatest honour on that hardy and honest class of men.

SECTION IV.—PARASITISM.

THE WARBLE-FLY AND ITS LARVA; THE GAD-FLY OF THE OX.

The subject which we have chosen for this section is one of great importance, even so far as its bearing upon the ox is concerned, and manifestly much more is it of primary moment when considered generally and in regard to its far-reaching issues among the various races of mankind. The phenomena of parasitism most intimately affect all ideas as to the evolution of, and the various connections existing between, the innumerable living animals and plants which we find around us in this wondrously constituted world of ours.

Many writers, for convenience' sake, draw a great distinction between those parasites which live on the external surfaces of other animals and those which live within their bodies. We do not think that this classification of animal parasites into the ectozoa and the entozoa is of any real value, just as we do not hold that a similar division of vegetable parasites into those which adhere to the surface of other animals or plants, and those which live within animals, would be anything but a most misleading and artificial arrangement.

In our remarks we shall not have time to do more than just touch upon the outlines of our subject, and hence we shall say but very little about the classification of parasites.

Viewed from a broad aspect, parasitism furnishes an example of those numerous kinds of antagonism with which the whole world of life is so painfully replete throughout its numerous and complicated ramifications. It is one of those groups of strange and closely-allied facts with which observers of natural history are very familiar. In common with all other living creatures, man himself is liable to the insidious and often fatal attacks of creatures quite insignificant, except in so far as their powers for mischief are concerned; and in this way, even when

death does not result, his vitality may be sapped and undermined to its very foundations. It is one of the deplorable but yet most true conditions of the existence of any living being, no matter how highly developed, that there is always a grave risk that life may be immensely impaired, and even made to cease, as a result of the inroads of parasitic organisms. From its commencement to its close, life is composed of a series of struggles; and the foes with which any given man, woman, child, or any animal of whatsoever kind or degree, is liable to be confronted, are by far more numerous and by far more formidable than any of us can adequately conceive.

In the progress of those subtle processes of equilibration and evolution, whereby the advancement of the race is made possible, the chances cannot but tell greatly against individuals, and it is only by realising this that those of us who are fairly healthy and well-off are enabled to see how thankful we ought to be for our preservation, not only from the more or less accidental disasters which may at any moment sweep us away from the face of the earth, but also from the hostile activities of the many animal and vegetable parasites by which we might at any time be grievously afflicted. There is something at once startling and mournful in the thought that men and women of the brightest intellect, and those possessing the strongest and healthiest frames, may be swept into the sea of eternity by the attacks of creatures utterly insignificant; that the most brilliant career may be blasted by the virus of some deadly fever which may lay low and destroy men, women, and children, rich and poor, good and bad, without discrimination.

There are, fortunately, two saving clauses to this picture; for, in the first place, our power to repel such invasions is daily increasing, and, secondly, it may be maintained that possibly there is a future life before us, in which, if we shall be able to look back upon this one, we shall probably do so with no regret that the change has been made from a lower to a higher kind of existence. Nevertheless, it remains indisputable that, optimistic as we may rightly be in regard to the future welfare and good destiny of mankind at large, we cannot but realise the appositeness of Tennyson's query :—

> Are God and Nature then at strife,
> That Nature lends such evil dreams?

and sometimes it may indeed seem difficult to comprehend the force of the idea of—

> —— one far-off divine event,
> To which the whole creation moves ;

the goal of which the same great modern poet so beautifully sings. Yet we may be sure there is such a star in the distance, if we could only see it; and each one of us may rejoice to think that, even if things are going in the wrong direction in many cases, still on the whole all things, ay, and even evil things, are working in the right way, and, in accordance with the inscrutable wisdom of some wonderful Power, are "making for righteousness."

If men had not this belief, the strange facts elicited in the study of parasitism would certainly shake to their very basis some current conceptions regarding the unlimited power of the divine will and purpose. Notwithstanding all these things, however, the doctrines of pure optimism cannot be overturned, if men will only think deeply enough. At any rate, we may feel quite justified in propounding and reiterating them, although we do not forget that often and often enough matters seem to be taking the wrong route, and that there are many denizens of great cities, and other human beings, who are literally starving for what some of the rich are throwing away and wastefully squandering. Proof upon proof can be supplied that, though the interest and the progress of the community at large may not be altogether and entirely the same as those of the individual units, still the two sets of interests are inseparably connected, and mutually dependent.

If we survey the whole kingdom of life from a broad standpoint, we shall find that any given living thing may be regarded both as being liable to be preyed upon and as also in its turn liable to prey upon others. On the one hand, therefore, care must be taken to acquire sufficient means of sustenance, while, on the other, each individual must beware lest he furnish food for enemies. Now, one of the great principles of biology is that a relation is very generally to be discerned between any animal or group of animals, on the one hand, and the environment, on the other. A resemblance, more or less exact, is often exhibited betwixt the peculiar stones, rocks, mosses, lichens, algæ, leaves,

flowers, or stems, with which any given group of animals is most intimately associated, and the group itself. Frequently, too, it happens that a remarkable power of adaptive change is to be noted; as, for example, in the case of the chameleon, which varies in colour according to its position in regard to external objects and places. The protective resemblances, so generally found among the class Insecta, are frequently of an extremely marked type, and it becomes a matter of great difficulty to discern the creatures, situated as they are in the natural state among the objects to which they are so strangely assimilated in form, colour, and general appearance. It is recorded of Mr. Wallace that he was in the habit of placing in a box some butterflies, appended, as they might perhaps be found naturally, to the stalk of a shrub, and, together with those thus arranged, another fully exposed to view. To his inquiry, "How many butterflies are there in that box?" the invariable reply of the observer was that the case contained only one single specimen. Then, after exposing one or two of those which appeared to be leaves, he continued: "How many are there now?" The reply was: "Oh! I see that all the leaves are butterflies, and hence it is only necessary to count the leaves in order to answer your question." But the naturalist had his friends once more at fault, for some were leaves and some were butterflies, although to the eyes of an unpractised observer all seemed identically similar leaves. Not only, however, do animals simulate inanimate objects and parts of plants in point of form and colour, but other animals also are so exactly represented that only an experienced naturalist can detect the superficial character of the resemblance. In intimate structure the greatest possible differences are to be observed. In some cases, insects simulate the very animals which prey upon them, while, in other cases, the wolf in sheep's clothing stands confessed when the would-be devourer is seen to resemble closely the objects of his greed. For instance, some spiders are very like their prey in size, form, and colouring, and one is known which actually imitates the actions of the poor fly, even in such a minute particular as that rapid moving of the falces which is so well known and so characteristic. Much stranger similarities, however, remain to be noted. When the sexes of the animals which are mimicked differ, the sexes of the mimickers sometimes also differ in a corre-

sponding manner. The reproduction in the mimickers of the most minute lines, of the particular kind of flight, of the mode of resting, are also to be perceived, while the fact that even varieties are copied, shows us to what extent this protective acquisition has been carried. It is matter of common observation that protective coverings are largely developed in numerous animals such, for instance, as tortoises, crabs and lobsters, the Hippocampidæ, or sea-horses, the amphisile, while the curculionidæ among beetles, exemplify the possession of a highly perfected defensive armour. The term "mimicry" was introduced to express superficial likenesses among animals which differ greatly in regard to intimate structure from those imitated, and the subject has been elucidated by the able researches of Wallace, Bates, Trimen, and others. Protective mimicry is only explicable on the theory of evolution, and the phenomena which are to be classed under this head afford some of the best arguments which can be adduced in favour of this induction. Of all biological subjects, one of the most interesting is the study of those extraordinary disguises which the exigencies of existence seem to have forced upon some animals. The investigation of such peculiarities is of still greater value, since we now look upon life not as one vast drama in which each animal and plant plays a subsidiary, purely temporary, and comparatively fixed part, but rather as a vast moving panorama, so to say, of which the concluding scenes, connected with the first as they are by laws of causation, are made ever the more perfect. Finally, what practical lesson can be derived from the study of protective expedients, as shown in the members of the animal kingdom? Paying due regard to the fact that such resources are most especially apparent in the lower forms of life, may we not justly infer that although protectionist measures may from time to time facilitate the maintenance and well-being of any given individual or group of individuals, still they do not, and probably never can, afford more than a transient succour, and that they are only apparently and temporarily helpful in the case of an aggregate which would otherwise be weak and retrogressive, if not effete.

In studying the strange phenomena of parasitism, one cannot but be struck by the extraordinary fact that the highest animals are oftentimes destroyed by the lowest, being completely at their

mercy. This may be consistent with the advancement of the community, for it may be necessary that the higher animals shall gain or keep the power of repelling such attacks; but it cannot be considered as anything but detrimental to the units attacked, when regarded as distinct individuals, and not as members of the ever-advancing aggregate. Indeed, this implication of the great law of evolution must probably be always more or less true; but as regards mankind the interests of the individual and those of the aggregations will become gradually more and more blended, in proportion as the strong, the powerful, and the wealthy realise the *raison d'être* of their advantages, and the best uses to which their strength and power and riches can be put. No matter what men's social distinctions may be, no matter how great their fame, they are all made up of flesh and blood, and nerves and bones, and all are subject to the attacks of parasites of divers kinds and degrees of power to destroy.

One instance of parasitism in relation to cattle which attracts marked attention, is the disease to which we have already briefly referred. It is popularly known as Husk or Hoose, and more scientifically as Parasitic or Verminous Bronchitis. This malady is, as we have said, somewhat difficult to cure. It often attacks sheep, and, as the latter name implies, it is due to the presence of the worm, called *Strongylus micrurus*, often in considerable numbers within the air tubes.

Another example will readily recur to farmers' minds. Especially in hot and sultry days, stock-owners will be glad to hear a little more about the two insects known as the warble-fly and the gad-fly of the ox, notwithstanding that Miss Ormerod, in *The Yorkshire Weekly Post* of May 14th, 1887, gave a lengthy and valuable description of these pests, and that Mr. John Walker's good little pamphlet on the subject is well known.

There are other parasites which also demand some attention, and we may mention the liver-fluke, which not only attacks sheep, but also oxen, and indeed many other animals. Tape-worms, in their connection with oxen, must also be briefly considered. The parasites of the skin of oxen do not need much notice, and they will be mentioned under our article on the skin.

The Warble-fly of the Ox.

In the month of July the warble-fly is still busy among the

herds. We propose to deal with this creature and the gad-fly first, and then we shall proceed to consider other parasites.

The picture below is taken, with apologies to Miss Ormerod, from her article above referred to. The bot-fly or warble-fly of the ox (*Hypoderma bovis*) is about half-an-inch in length, and the general appearance is not unlike that of the bumble-bee. The annual pecuniary loss occasioned by this insect and by the gad-fly of the ox is very great. One of these insects on a hot summer's day is capable of upsetting a whole herd, and it is just possible that they may be the means of transmitting blood diseases, as well as of bringing about other well-known damage. About the year 1825, these creatures appeared in large numbers

Fig. 54.—The Warble-fly of the Ox, and its Larva.

in France, causing considerable mischief, fever, and death. They are very generally present in cattle imported from America and other warm countries, and hence any preventive measures should certainly include the destruction of the larvæ in oxen brought from abroad, so far as might be found practicable.

It is in the latter days of May, in June, July, and also in the beginning of August, that the female warble-fly of the ox is busily engaged in laying its eggs on the backs of horned cattle. The oxen are terrified, and, in order to escape their tormentors, will dash madly into the thickest fences. If the ploughman be engaged in ploughing with oxen when the warble-fly and gad-fly are on the war-trail, he will lose all control over his team; and hence on hot and sultry days the ploughing has to be deferred until the cool of the evening, when these insects are not on the wing. Having deposited its egg or eggs, the warble-fly returns to the hedgerows or woods, in order to procure a supply

of vegetable food. The creature dies when the cold nights of autumn come on. The gad-fly sucks the blood, while the warble-fly's object is merely to lay its egg or eggs in the suitable hatching-place which is afforded by the backs of oxen. Towards Christmas-time, little enlargements appear on the backs about the chine, on the loin, or top parts of the ribs. These continue to increase in size until the spring, and they become half as large, or even quite as large, as a small walnut. About this time the irritation set up is of such a nature that the ox is fain to lick certain parts with some vigour, and this may be taken as a sign that the egg has been hatched. A slight aperture is formed in the skin by means of which the grub can receive air. Towards the end of January, and much more markedly towards the end of February, this opening may be found.

The breathing apparatus in this fly and other bot-flies is situated at the tip of the tail, and this tip, which is of a blackish colour, can be seen through the opening spoken of. This opening or air-hole through the ox's skin seems to be enlarged by the pressure occasioned by the growth of the larva. The mouth is placed below, and is engaged in feeding upon the ulcerated matter produced by the perpetual suction which the larva keeps up. Towards the beginning of May, the grub has nearly completed its larval state, and at about this time the air-hole is about a quarter of an inch in diameter. In May the full-grown warble, about an inch in length, issues from its hole about mid-day. It presses itself out of the hole, tail first, and falls to the earth, where it finds some shelter, and changes into a chrysalis. It is at first grey, but gradually becomes darker, as this transformation is going on. The outer covering or shell of the chrysalis is very strong, and dark brown or black in colour. About four weeks after the larva has fallen to the ground—that is, at about the middle of June—the fly formed within the shell of the chrysalis frees itself. The female flies become impregnated, and shortly afterwards they select a sultry day on which to deposit their eggs in the skin of the back of an ox. Each female fly deposits one or more eggs.

In order to protect cattle from the attacks of this pest, McDougall's Carbolic Dressing, as sold in tins, may be dissolved in soft water, in the proportion of two pounds to six gallons of water. This would be sufficient for about seventy-five beasts.

The application should be made about once a week at suitable times, by the aid of a large soft brush, along the spine to the root of the tail, and about a foot downwards on each side of the spine. The strong odour keeps all flies off, and it possibly destroys any eggs which may be there already.

Mr. John Walker recommends this measure, and that whale oil and train oil, and in fact every kind of oil, should be avoided, since the ox is rendered miserable by the smell of these substances, on account of its fine sense of smell, and moreover refrains from licking itself, if they be present.

A mixture of four ounces of flowers of sulphur, of one gill of spirit of tar, and one quart of train-oil, well-mixed, and similarly applied once a week along each side of the spine, has also been advised, as also has a mixture of spirit of tar, linseed oil, sulphur, and carbolic acid. Sheep salve, or sulphur mixed with an equal part of lard or tar, and Stockholm or green tar, and also washes of strong brine have all been found useful. Five applications should be made in June, and five in July. Sultry days should be selected for the purpose, and on these days the animals should be driven to a shed and dressed, and then kept under shelter until the cool of the evening has set in.

Dairy-cows could be treated in this way with but little trouble, and those beasts which are to be killed before spring are not in such great need of protection, since the grub, being very young at the time when the animals are slaughtered, will not live to produce further mischief.

If the grub has been developed, it can be destroyed by plugging up the hole through which it obtains air, and this can be effectually done with mercurial ointment, or with sulphur ointment, or with the ointment of carbolic acid of *The Veterinary Pharmacopœia* written by ourselves (which is just the same ointment as that of *The British Pharmacopœia*). If every hole is filled up in this way, the grubs will die partly from the effects of the ointment, and partly as a result of the lack of power to breathe.

Further, during the month of April, the veterinary surgeon should examine all the oxen, and cut the tumours, and remove the grubs, and in this same month all foreign beasts imported should be in like manner inspected. If such precautions as these were carried out for three years, and all imported oxen

always carefully examined for bots every April, no doubt the pest might be exterminated and kept out of this country. So says Mr. Walker, and he is quite right in this, as in most of his advice to agriculturists. This observer remarks that he has seen the mischievous magpie, the sly jackdaw, and the harmless starling, in the spring-time, picking out the grub from the backs of cows.

The losses which result from the attacks of the insect are of divers kinds. Among beasts which are fattening, the creature appears at a time when flesh should be rapidly laid on, and it causes terror and disturbance. For days together the oxen may be well-nigh maddened, the pain produced when their thick skins are being pierced by the fly being, no doubt, very severe, and of a very irritating character. Even the strongest oxen seem to know that they have little or no chance of coping with their insignificant foe, whose approach is indicated by the dreaded whir. Hence, in their wild attempts to escape, beasts not infrequently meet with grave accidents. Breeding cows may abort in consequence of the excitement undergone, and it is indeed a painful sight to see the oxen with heads and tails uplifted, nostrils expanded, scouring the fields in a frantic state. It should be remembered, too, that animals which have brought forth their young prematurely once, are very liable to abort again and again, and also to transmit the same tendency or habit to their companions. This is a well-known fact.

When the egg of the warble has been deposited, and the larva has been hatched, and is growing, a considerable amount of irritation is set up, and the beast, in consequence thereof, fattens more slowly. In the case of a milch-cow, the milk, after a day of such excitement, is scanty and of poor quality, and it will not keep long. Again, the damage to the hides on account of the holes present in them is a source of serious loss. Even this is not all, for the beef around each warbled spot is found to be replaced by a yellowish jelly, which is caused by the beast licking or rubbing itself with the purpose of getting rid of the grub, as well as by the disturbance set up more directly by the grub itself. These parts are cut off by the butcher, but there is necessarily an appreciable loss, and the best parts of the beast certainly do not look any the better for having been thus treated.

Indeed, adding together every source of damage, we may roughly estimate that the annual loss to the people of Great Britain as a result of this mischievous pest is as much as about four and a half million pounds sterling; and, in saying this, we would also impress upon our readers that it is the healthiest oxen, with soft, mellow, and highly nutritious skins which are most likely to be subjected to the ravages of this pernicious fly.

We have mentioned the *gad-fly* of the ox, which is an insect of a character very different from the warble-fly. The gad-fly drives its jaw-lancets into the skin of cattle, and then sucks

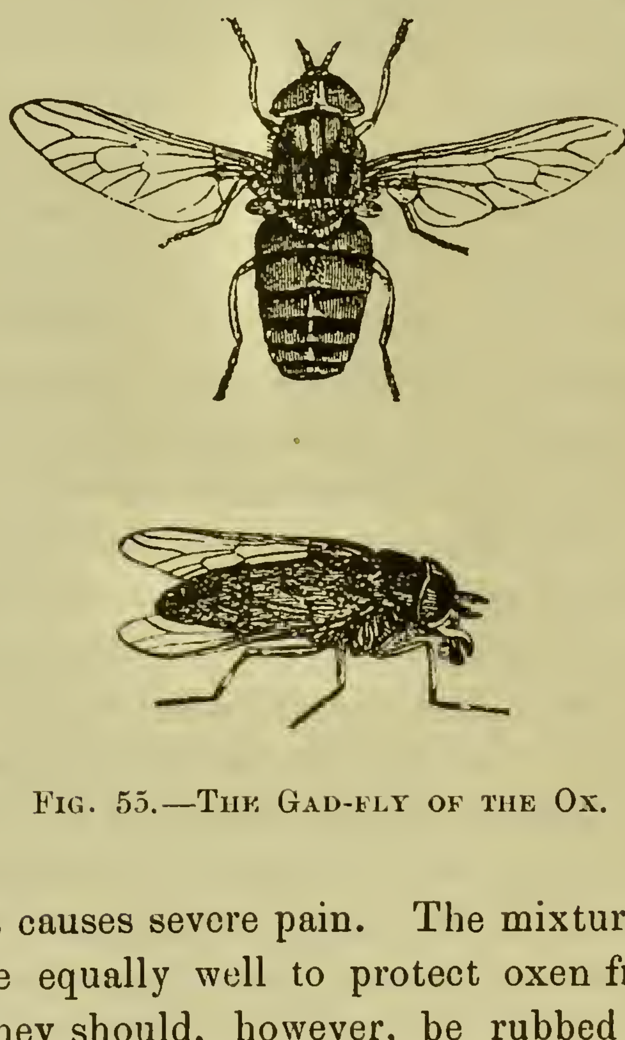


Fig. 55.—The Gad-fly of the Ox.

their blood. It causes severe pain. The mixtures recommended above will serve equally well to protect oxen from the attacks of this fly. They should, however, be rubbed more generally over the beast, and lower down, so as to include the brisket.

It is desirable that oxen should have the power of sheltering themselves in sheds; and shallow pools also are serviceable, since it is said that the bot-fly will not pursue its victim over water.

In concluding our remarks, we should point out, in regard to the bot-fly, that those farmers who take in hand to destroy the pest will individually profit by so doing, since the maggots, if allowed to mature, become flies, and the herds in the same fields are attacked year after year.

SCABIES IN SHEEP.

The affliction known as scabies is one of very wide and far-reaching importance. The value of the sheep consists in great part of the fleece, and, as all sheep-farmers know, the disorder generally known as sheep-scab works an immense amount of havoc not only with the fleece, but also with the animal itself. It appears that there are three distinct forms of scabies,

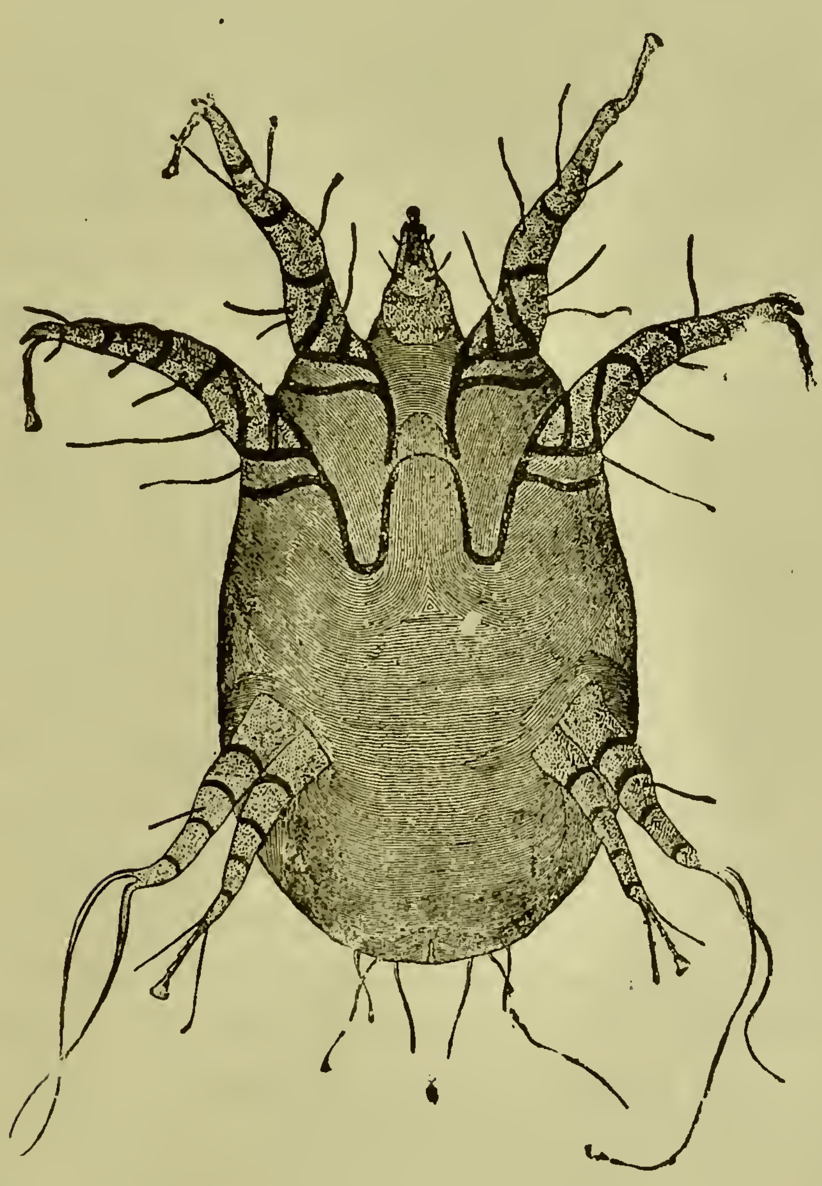


FIG. 56.—THE DERMATODECTES OVIS.

namely, the Psoroptic, the Sarcoptic, and the Symbiotic varieties. Of these the first is by far the most common, and it seems to be the only kind which has been recognised in this country. Hence we shall deal with the psoroptic variety only.

In the first place, it may be said that it is occasioned by the ravages brought about by the little creature known as the

Psoroptes ovis, which multiplies at a very rapid rate, and gives rise to all the mischief by burrowing in the skin. We append here a picture (after Gerlach) of the creature called by Gerlach the *Dermatodectes ovis,* a very similar, if not the same, creature.

Sheep-scab is not uncommonly met with. It is very well known to, and very justly dreaded by, all who have to do with sheep. The Psoroptes ovis, though it closely resembles that of the horse and that of the ox, is not capable of infesting these animals or the goat. Moreover, when it gains access to the skin of a man, it only produces a minute red spot, which does not even develop into a papule. The rate of multiplication of the creatures is very rapid. A single impregnated female Psoroptes will, in the space of thirty-one days, give rise to the formation of a patch of scabies nearly two inches in circumference. Some countries are never free from sheep-scab, and from them the disease may always be communicated to other places. Sheep fairs are largely instrumental in the propagation of the disease, as also are railway-trucks and cattle-boats, if they are not thoroughly disinfected.

Sheep-scab is very similar to, and, in fact, representative of, the malady known as mange in the horse, ox, dog, and other animals, and the disease commonly designated the itch among mankind—a malady fortunately rather rare. In the case of the sheep, scabies is of exceptional importance, owing to the fact that the animal is provided with a thick coating of wool. The little creatures which cause the disease are so well sheltered by the bulky fleece that it is a matter of difficulty to poison them, much more so, of course, than it is to effect the same object in the case of animals which have but little natural covering on the skin. Moreover, we must bear in mind that the skin of the sheep is endowed with the very important special property of producing the wool, and consequently that any cause which markedly interferes with the functions of the skin must necessarily be liable not only to give great distress to the animal, but also to throw the working of the system at large sadly out of gear. Again, the sheep, afflicted beyond all measure by the itching, rubs and tears its skin with great violence, thus producing much mischief.

If the malady has once succeeded in establishing itself in any

individual member of a flock of sheep, it will, unless curative and preventive measures be at once taken, propagate itself with the greatest rapidity from sheep to sheep. The ease with which this complaint, and others liable to afflict the sheep, are transmitted arises in some degree from the fact that, partly from their own habits and inclinations, partly owing to the convenience of sheep-farmers, these animals are usually kept in close contiguity with one another. Hence sheep-scab, when once it has been introduced into a district, usually spreads with marvellous celerity.

Moreover, sheep are moved about a great deal in accordance with the exigencies of the food-supply. A farmer may, for instance, possess a large quantity of turnips which he does not require for his own sheep, and hence he sells them to be eaten on the premises in separate instalments. Sheep-farmers send their sheep from a distance, and hence, perhaps, while one flock may bring the disease, others may become tainted, even if separated by turnip-trays or other partitions. The infected sheep will rub off their wool on the trays, and other sheep coming into contact with the detached wool from the other side may easily become affected. Obviously, if a hurdle should fall down, still more direct contact of healthy with infected sheep may ensue. When the sheep have finished their turnips, they are taken back to the farms from whence they came; and the result is that sheep-scab, soon after their arrival, breaks out and spreads far and wide from this new centre. Sheep infected with the scab, being moved about the country, thus carry the tiny creatures burrowing in their skins to fresh centres, from which the disease again radiates.

Farmers cannot be too careful in regard to this complaint, and it is not too much to say that sheep-scab is one of the most important of all the disorders of the sheep. Consequently it is of the most pressing necessity that the disease should be stamped out, and in order to effect this object, prompt treatment alone can be efficacious. In fact, so great is the need that sheep-scab should be kept down in the country that the repressive measures are enforced by the authority of Her Majesty's Government. When sheep-scab is known to have broken out in any given district, the fact must be at once notified to the Local Authority, and stringent measures will

then be taken with a view to staying the further progress of the malady. The fact is that the sheep is one of the most valuable animals which a farmer keeps, and that an outbreak of this disease in a flock of sheep would in many cases entail a money-loss almost disastrous in amount. If not relieved, the afflicted animals will probably die, or, if they live, may become well-nigh valueless.

When a farmer is attempting to put a stop to the disease, he may often find it a very arduous matter to cure the worst cases completely, and since these may, so long as they are allowed to live, give the disorder even to sheep which have already been cured, it is the wisest course to have them summarily slaughtered and their carcases buried. In some instances the Local Authority should be advised to order that sheep which are very badly afflicted be made away with. It is often very difficult to decide if the malady has actually ceased to exist among the many members of a large flock. The disorder is more troublesome in winter than in summer. In the warm weather the sheep can be shorn, and if the fields be dry and the pasturage good, the spreading of the complaint can be, by the exercise of due care and precautions, quickly arrested.

If scabbed sheep have been kept under shelter, the quarters should be thoroughly cleansed and disinfected, and all posts and the like which have been used should be, if possible, tarred or painted, for it has been recorded that healthy animals on one occasion took the infection by being placed in an uncleansed stable in which scabbed sheep had been kept eight months previously. This seems almost doubtful, but Gerlach maintains that at least four weeks should be allowed to elapse before buildings, pastures, or roads, which have been much frequented by scabbed sheep may safely be opened out to healthy flocks.

Now, in regard to the symptoms manifested by sheep suffering from scabies in its early stages, it may be said that the malady is rather difficult to detect at first. One sign, which, however, is not a very early one, is that sheep which are afflicted with the disorder will, when they are scratched or rubbed with the hand along the back or elsewhere, be pleasurably excited to such an extent that they will express their delight by stretching out and shaking their heads and necks, also by a peculiar kind of convulsive champing with the under lip ("knapping," as the

shepherds call it), and even trying to bite playfully those who give them this satisfaction. It is, however, said that sheep will also do the same thing when they are afflicted with red lice.

If the wool be parted so that the skin can be seen, prominent spots or papules may be in the first instance observed. These spots are of about the size of a lentil, and are pale or reddish yellow. Little vesicles are developed on them, and then a small crust or scab is formed. The little creature itself may be found at a little distance among the fibres of the wool. If a little of the scurf taken from a sheep suffering from the complaint be placed on a plate of glass, and be closely inspected by the aid of a pocket lens, the scurf may possibly be seen to move. If then a powerful microscope is brought to bear upon the object, the identity of the minute but very harmful creature can be established beyond doubt.

Owing to the intense itching caused, sheep afflicted with scabies evince a characteristic restlessness. They are constantly rubbing themselves against posts or hurdles, gates, rails, or, indeed, any object suitable and situated conveniently for the purpose. They also endeavour to bite or scratch the affected parts, as, for instance, with the hind foot. Consequently one of the first signs of the malady is the presence of a dirty mark in the region of the shoulder and neck, produced by the soiled hind-foot being used for the purpose of scratching those parts. As a rule, the back of the animal extending from the neck to the tail is usually affected, as also are the sides of the body and the shoulders, those parts, in fact, where the parasite can most effectually shelter itself in safety.

When the malady has made much headway, so great is the irritation produced that the sheep may become well-nigh desperate, and, in their vehement and frantic efforts to rid themselves of their insignificant but insidious foe, they will tear off great tufts of wool with great violence, thus leaving bare white patches, and so producing a very ragged and wretched or "trailed" appearance. Here the wool may be matted together, while there it may be absent, and in other parts it may be loose and easily removable. Moreover, the skin becomes fretted and thickened by the rubbing, an ichorous fluid is exuded, the vesicles meet and become pustular, firm, and thick; whitish crusts or scabs

are formed, while beneath and on the borders of these crusts the parasites thrive and multiply.

If these crusts are detached, the wool, if it still remains, is readily also removed, while the underlying skin is thickened, and wrinkled, and fissured, and for a long time inflamed and scaly. The continuance of both the irritation and the rubbing makes matters worse and worse, the wool comes off almost entirely, and even deep sores and obstinate ulcers result. At length the animals may succumb, worn out by exhaustion, the weakly ones dying even within a few months after the infection.

It is said that in Germany the loss is seldom less than 10 per cent. of the sheep attacked, and also that the annual loss in France is as much as 5,000,000f., 1,000,000 sheep being affected and depreciated in value to the extent of 5f. each on an average. In this estimate the damage by the animals becoming emaciated and losing their wool is included.

The Measures to be Taken in Order to Prevent the Spread of Scabies in Sheep, and to Cure that Disease.—It is at once a strikingly peculiar and most suggestive fact that all kinds of animals are liable to be infested with parasites, and this is true not only concerning the external surface of their bodies, but also of their interior. That animals are attacked by fleas, by lice, and other irritating creatures is a fact more generally known than that in the interior of their bodies they are not free from the insidious inroad of divers foes. In the digestive canal tapeworms and other worms may be found.

We have previously alluded to the flukes, which, by their presence in the livers of sheep, give rise to sheep-rot. We shall soon speak of the worms, which by their presence in the air-tubes bring on verminous bronchitis, and also of that cystic stage of the tapeworm, which, by its growth in the brain, produces sturdy or turnsick; and we may also mention in this connection the *Filaria sanguinis hominis* which has been found living in the blood of human beings, and also the trichinæ, which find their way into the muscles of men and women. Indeed, the general subject of parasitism is one of the most intense interest, and the facts we learn from studying it are of immense importance. To this statement the sheep is by no means to be regarded as an exception. In connection with

this same topic, we now come to the consideration of the measures which should be taken with a view to kill the little creature known as the *Psoroptes ovis*, which produces such grave mischief, and to arrest its multiplication and extension to other sheep.

In the first place, with regard to the repression of sheep-scab, the measures to be taken cannot be too stringent or too carefully carried out. Immediately that the disorder shows itself among a flock of sheep, all the animals composing that flock should at once be carefully inspected, and those sheep which manifest the slightest signs of infection should be without any delay taken away to a field or other quarters at a distance.

It is advisable that all the sheep composing the flock should be dressed with a suitable application. Now, for this purpose farmers generally use mercurial ointments of different strengths, but usually very much too strong and in too great quantity. We cannot unduly emphasise the fact that sheep are very liable to be actually poisoned by this process. The ordinary ointment of mercury is made by rubbing together 16 parts of mercury, 16 parts of prepared lard, and 1 part of prepared suet, until the metallic globules of the mercury can no longer be seen. It is important to bear in mind that this ointment is too strong, and that before being used for sheep—if farmers will use mercury at all—it should be well mixed with about four or five times its weight of lard. In mild cases of scabies, 3 lb. to the score of full-grown sheep and 2½ lb. for younger animals (about two-thirds of an ounce for a lamb) is often used by shepherds.

In order to apply this ointment, or any other unguent, the wool should be parted along the back of the sheep, beginning from near the head and carrying the line of parting as far as the tail, and then the ointment should be neatly placed upon the skin with the finger. Then, at a distance of four inches from this line, another is made, and so on at intervals of four inches for the whole body. It is necessary to bear in mind that the mercury thus placed upon the skin is absorbed into the body, and produces the effects of this drug, and consequently that, after being thus dressed, the sheep should be kept under shelter for some nights following, since they are likely to catch severe colds, when under the influence of this dangerous substance. After the night-shelter is dispensed with, as being supposed to be no

longer necessary, the sheep should be placed so that they can go and lie down on straw, under shelter, of their own accord. These sheltering places should be provided in the fields wherein the sheep are pastured. Another great point is that sheep should never be "salved" in cold or wet weather.

The way in which sheep are sometimes treated is really a very great mistake, and we cannot wonder at the disastrous losses which occur at times. When sheep are undergoing treatment, they should be supplied with good and strengthening food, and they ought to be inspected once a week until the disorder is entirely suppressed. There is greater need of complete cure in the case of this disorder than of some other maladies, for if only one impregnated female *Psoroptes ovis* is alive on any one member of a flock, the malady may spread and spread until all the sheep are attacked, and even those which have been thoroughly cured, may become as bad as they ever were, or even far worse.

When we consider that these creatures can only just be seen with the naked eye, we cannot wonder at the difficulty of getting rid of all of them, nor perhaps even at the reckless way in which some persons place the mercurial ointment on the sheep, so that, even at the risk of killing large numbers of them, the disorder may be put a stop to. The fact is, however, that little good, but, on the contrary, a great deal of harm, is done by applying large quantities of mercury, even if it be decided to risk the poisoning of some sheep, and the debilitation of many, in order to cure the malady. In any case the killing of all the parasites is a question of time, and small quantities of mercury neatly and carefully applied will be much more efficacious than large quantities carelessly used.

If any sheep should die, as may well be expected if they are put under the influence of mercury in wet or cold weather, or, indeed, in warm weather if the ointment be too freely used, the rest of the sheep should be washed in order to remove the ointment. If the weather be warm, the cure may be greatly facilitated by shearing the sheep, for when the fleece has been removed, the application which we shall mention lower down can be more effectually applied. However, we must remember that the presence of an oily or fatty substance on the skin is in itself a source of danger, for the skin, when thus clogged up, cannot at all well perform its due functions in the right way. The grease

stops up the pores of the skin, and so works a great deal of mischief. It is really best to wash the ointment off, after it has been on a day or two, and then to apply it again. The risk of arresting the functions of the skin, which is a serious one, may also be in some degree obviated by using lotions in preference to ointments.

In regard to mercurial ointment, we may say that it ought not to be used at all for sheep, and it is our opinion that before very long it will be altogether discarded. Undoubtedly it seems to possess the power of poisoning the little creatures which cause the scab; but, unfortunately, as we have said above, in this case it is true that "what is sauce for the goose is likewise sauce for the gander," and it is an undoubted fact that sheep are often poisoned by the use of the ointment, and very frequently or even generally mercurialised (salivated) by it, and thereby deteriorated in value. The sheep may be seen to slaver profusely, their teeth become loose or even come out, and it is no uncommon thing to find that four or five sheep have died, and that many are greatly debilitated. In not a few instances the fatal result may ensue at about the tenth day after the application.

Ruminants as a class, and of these especially sheep, are readily poisoned by mercury, or by salts of mercury. In fact, it is very necessary that sheep-farmers should realise the dangers occasioned by "salving." Besides the ointment of mercury, there are other curative agents containing poisonous substances which should be altogether avoided, or, at all events, very carefully used; for example, those concocted of any of the salts of mercury or of the preparations of arsenic. As a matter of fact these should not be used, since they are very deleterious, and must be condemned. Dressings which are not poisonous should alone be used, and they ought not to be applied too thickly.

We would wish to draw attention to a preparation composed of stavesacre and sulphur, made by mixing together in equal proportions the ointment of sulphur and that of stavesacre. For the mode of preparation, which is very simple, of these two unguents the reader is referred to the *Veterinary Pharmacopœia*, by Gresswell, published by Messrs. Baillière, Tindall and Cox, of 20, King William Street, Strand (pp. 379 and 380).

A preparation has been recommended composed of 2 parts of oil of tar, 40 parts of castor oil or lard, and as much sulphur

as practicable, the ingredients being well mixed together. A very good preparation may be made of 1 part of creosote, 10 parts of spirit, and 30 parts of water. This has been proved to kill the parasites, when they are brought into contact with it, in about $1\frac{1}{2}$ minutes. Another very useful but somewhat dangerous application may be made by boiling 1 part of tobacco in about 25 parts of water; and one more may be mentioned, viz. a solution of sulphuret of potassium in about $7\frac{1}{2}$ parts of water.

A sheep-dip has been recommended of the composition of 3 lb. of arsenic, 3 lb. of carbonate of sodium (or of soda-ash, or of pearl-ash), 3 lb. of soft soap, and 3 lb. of sulphur. These ingredients may be dissolved in a quantity of boiling water, and the resulting solution may be added to about 100 gallons of water.

It is very highly important that sheep afflicted with scab should be effectually cured, and in order to achieve this object several dressings are often necessary at intervals of about a week or so. It is impossible completely to express the utter folly of bleeding sheep afflicted with scabies, and it may be said that internal treatment is of little or no use. Fields in which the contaminated sheep have been kept should not be used for sheep for at least two months, and all rubbing places should be as far as possible disinfected with carbolic acid solution, or painted, or tarred. All wooden enclosures at markets should be replaced by iron pens. Wood readily splinters, and portions of infected wool, or the little creatures themselves, are easily preserved by the woodwork from one market day to another. Moreover, after each market or fair has come to a close, the pens and so on should be well washed out with solution of carbolic acid in a large quantity of water. Trucks and steamers used for conveyance of cattle and sheep should also be kept thoroughly disinfected and clean.

Farmers cannot be too careful in regard to sheep-scab. Directly the disease manifests itself in any member of a flock of sheep, prompt measures should at once be taken to stamp it out. The disorder exists in England at the present time; there is danger of its spreading, and it is, therefore, of urgent moment that sheep-farmers should be well on their guard, and that the malady should be arrested without the least delay. Sheep which have been afflicted should at once be slaughtered, and their carcases should be buried, fleece and all. It is dangerous to use

the wool taken from a sheep afflicted with the scab, on account of the possibility of transmitting the malady to other sheep.

CERTAIN EXTERNAL PARASITES OF THE SHEEP OTHER THAN THAT WHICH CAUSES SCABIES, TOGETHER WITH AN ACCOUNT OF THE PARASITIC DISEASE OF THE BREATHING ORGANS OF LAMBS, OR VERMINOUS BRONCHITIS.

We spoke above of the creatures which produce scabies, and now we pass on to the consideration of the other parasites which infest the skin of the sheep. Of these the best known are those which, under the name of sheep-fags, are very familiar to farmers. Before, however, we describe these creatures, we have in the first place to point out that in the fleeces of sheep maggots are occasionally liable to be deposited by the large blow-fly (*Sarcophaga canaria*) in hot and sultry weather.

The attacks of the fly, the maggots of which infest the sheep, are owing to the large quantity of organic material which is present in the sheep's fleece. The blow-fly, seeking for suitable quarters wherein to lay her eggs, is attracted by this, and the consequence is that, unless they are killed without delay, these disgusting creatures thrive and distress the sheep, sometimes almost beyond endurance. Moreover, especially in the case of horned sheep, wounds may be inflicted on one another, and in these wounds the blow-fly may find just the places required for the growth of her offspring. Wherever the noisome creatures gain their footing, they may burrow into the skin and devour the flesh of the sheep to such an extent, that even death may ensue.

It has been recommended that a mixture of oil and sulphur, sufficiently thick for convenient use, should be applied to wounds liable to be infested with maggots, by the help of a brush, the preparation being carried about in a suitable tin. Probably some antiseptic ointment, such as that of carbolic acid or that of salicylic acid, is preferable for this purpose. The flock should be clipped rather early, if the sheep are troubled with these creatures, and after being shorn they should be dipped. If the heads are affected, the preparation used should be applied once a week, or at least once a fortnight during the fly-

season. A small amount of spirits of tar may be added to the oil and sulphur.

We now pass on to the louse of the sheep, the creature which is depicted in the figure which next meets the reader's eye.

The head of this creature is nearly orbicular, and the third joint of the antennæ is the longest and clavate. The scientific name of the creature is *Trichodectes sphærocephalus.* The ticks, keds, or fags found on the skins of horses, cattle, sheep, and dogs are parasitic species of the genus Ixodes, and belong to the class of Arachnida, of which spiders are also members.

The next creature we have to consider is the *Melophagus*

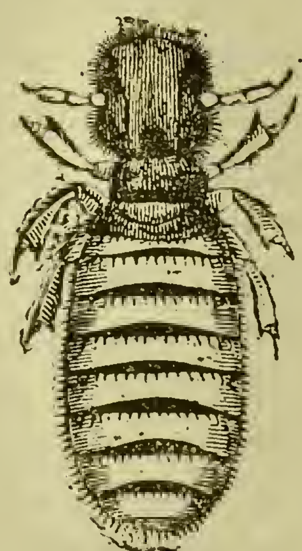


FIG. 57.—THE TRICHODECTES SPHÆROCEPHALUS.

ovinus, which attacks the sheep. It has no wings, and is dark red in colour, except that the belly is white. It is often called the sheep louse. According to Ray, it will live in a fleece for twelve months after removal from a sheep's body. These ticks are especially numerous on ewes in the spring, and when the ewes are shorn, the lambs are tormented by the ticks passing on to them from the ewes. Hence it is advisable to dip ewes before shearing them, in order that these parasites may thereby be killed.

We now come to the consideration of verminous bronchitis of lambs, a malady more generally known under the name of husk or hoose, and one the outbreaks of which are sometimes enormous in extent. Indeed, the disease is especially one of

importance on account of the large number of lambs which it attacks. It is particularly prevalent in the latter part of summer and the early part of autumn in low-lying damp localities, although it is by no means confined to them, being, for instance, very common on the Wolds of North Lincolnshire. The length of the male *Strongylus filaria*, the worm which causes the malady, is about $1\frac{3}{4}$ inch, while that of the female is somewhat in excess of this. In older sheep the worms are generally found encased in the tissue of the lungs, whereas in lambs they are generally present in the air-tubes.

The lungs of sheep which have been infested with these parasites contain large numbers of little rounded masses, some hollow and containing fluid, others containing semi-fluid matter, while others again are very hard and calcareous. The different characters of these little nodules, which vary in size from that of a mustard seed to that of a lentil seed, represent different stages in their growth. Each nodule contains tiny worms lying coiled up within. These little masses do not of necessity cause very much mischief, though they may bring on great weakness and death.

If the carcase of a lamb which has died of verminous bronchitis be examined, the wind-pipe and the air-tubes will be found to be more or less choked up with worms. Mr. Crisp believes that the worms pass in the first instance into the stomach, and then, by the regurgitation of the food which precedes the chewing of the cud, make their way into the breathing organs. Another view is that the eggs of the parasite are taken into the stomach together with the food. From the stomach the young parasites gain access into the circulation, and thus make their way into the lungs.

Those who hold that the lambs take in the eggs of worms discharged by the older sheep readily explain the fact that a whole flock may become infected by the ova and parasites expelled by even apparently healthy animals; for, as we have above pointed out, sheep do not by any means invariably manifest symptoms of the presence of these uninvited guests. The view entertained by the late Professor Cobbold is probably correct, namely, that the parasite passes one stage of its existence in the body of the earthworm or of some mollusc, which discharges the immature parasites upon the grass. While

the young lambs are grazing, the immature worms attach themselves to their noses, and are conveyed up the nostrils and to the breathing organs.

The worms usually infest the breathing organs of lambs, and the inflammation and irritation thereby set up cause incessant coughing, and the discharge of frothy mucus from the windpipe. The breathing becomes quickened, and great debility and loss of flesh ensue. Older animals may exhibit no signs of the presence of the worms, but weakness and great loss of flesh are necessarily brought about in many cases. In some instances the worms are found in the intestinal organs, as well as in the lungs, and sometimes indeed the intestinal tract alone harbours them.

When the intestines are invaded by strongyles, there is usually much straining and frequent passage of excrement, which is not uncommonly mixed with blood. In the case of older animals, pain in the abdomen, thirst, and weakness are often exhibited. In these instances, when the intestines are invaded as well as the lungs, the irritation set up by the parasites is often so great as to bring on death very quickly. It is by no means an unusual thing for a farmer to lose twenty lambs out of a flock of about 350.

With regard to treatment, it is to be pointed out that when the bronchial tubes are choked up with worms drugs are but seldom of much avail, and even in milder cases most careful management is to be considered of the first importance. Some have recommended the inhalation of gases, such as chlorine and dioxide of sulphur; but there is great danger of the animals dying, unless extreme care is exercised in carrying this out. Again, some have advised the administration of turpentine in conjunction with linseed oil; but it is well to remember that many deaths have been caused by choking during the administration of this remedy. Of course choking must always be very carefully guarded against in the administration of any fluid whatever to lambs, but in the case of turpentine there is especial danger.

When giving medicine to lambs, it is particularly advisable that the head should not be held above the horizontal line. Moreover, turpentine often does more harm than good to small lambs, though in the case of calves suffering from verminous

bronchitis the matter is different. When the worms infest the intestines of lambs, turpentine may be given, provided that due precautions be taken against choking; but there are far more effectual remedies. Plenty of cake may be allowed to the affected animals, and a small quantity of salt may be added to the food. In case a flock is infested, medicine should be given to each member of it, and two minutes should be occupied in the administration of each drench.

With regard to preventing attacks by the strongyli, it is to be enjoined that lambs should be placed on fresh dry pastures, and that they should not be fed upon a second crop of clover, when the first crop has been fed upon by sheep. The pastures from which the lambs are removed should be well dressed with salt, in order to destroy the immature worm.

Before we pass on to the consideration of other parasites, let us now pause for a moment or two to take a rapid and sweeping, but yet thoughtful, glance upon the dense and wondrous world of living organisms, of which man himself exhibits the highest form of development. In looking at this immense living aggregate, we cannot fail to note many general points regarding both union and antagonism which demand our most serious attention. Of all the great truths concerning the huge mass of living creatures, viewed in its complex entirety, perhaps the most important is the observation that all animals and plants are at once very intimately connected one with another, and at the same time extremely diverse, and essentially opposed in their habits and pursuits. The most striking generalisation in relation to life, as in reference to the universe at large and to every portion of it, is that there is manifested a very marked degree of combination betwixt the most dissimilar units, whether living or lifeless. This leading feature is shown in many different ways, as well as in the marvellous set of facts which we are now considering.

The strange phenomena which come under the heading, Parasitism, afford examples of a peculiarly insidious nature of the struggling which is always going on throughout the living world, also instances of startling combinations between the most dissimilar animals.

The dangers belonging to the attacks of parasites partly consist in the fact that they are so well hidden that they can only

be directly guarded against by a considerable amount of knowledge. It is a not uncommon belief that healthy people and animals are less liable to the attacks of these unwelcome invaders than those who are in a weakened or debilitated state; but as a matter of fact the direct opposite of this is more probably true. At any rate parasites are quite as likely to attack healthy individuals as unhealthy ones. A young lady with the bloom of health upon her cheeks is quite as liable to catch the germ of a tapeworm, from caressing with too much fervour a favourite dog, as would be the hard-working gardener or groom, should he engage in the same pastime. The ox which is fattening rapidly in the rich pastures, and has a superabundance of health and vigour, is even more likely to be singled out for the attacks of the warble-fly than is a less healthy comrade. The best members of a herd of cattle may be the first to be attacked by, and the first to die as a result of, cattle-plague, just as also the well-nourished of the human family have been at times the most seriously affected by typhus fever.

As everyone knows, animals live directly or indirectly on the members of the vegetable kingdom, and hence they are dependent upon plants, inasmuch as they cannot do what plants can do, viz. derive their nutriment from the inorganic constituents of the air and soil. This primary necessity, that animals should be helped by the vital activities of plants, is the best and most important instance of the intimate connection which subsists between the two great kingdoms (as they are called) of living organisms. This particular dependence may certainly be looked upon as one of mutual advantage; but, notwithstanding the benefits accruing from this, and very many other like instances of division of labour among living beings, it must not be overlooked that the kind of inter-dependency which is shown in parasitism is very generally a source of serious danger and disturbance, and even death, to the higher animal at whose expense the uninvited guest takes up quarters, and furnishes itself with board and residence, free of cost.

There are numerous kinds and degrees of parasitism. Some instances of plants which live parasitically on other plants, and also on animals, will readily present themselves to the mind. The dodder attaches itself to plants such as the flax or clover.

Ergot is, as we recently pointed out, parasitic upon various grasses. The mistletoe is an evergreen plant, formerly held in great veneration by the ancient Druids, and growing upon apple and oak trees. The *Sarcina ventriculi,* a vegetable organism which takes up its abode within the human stomach, affords an instance of a vegetable being parasitic in the interior of an animal. Moreover, there are different vegetals which grow upon the skin, forming, for example, ringworm, while in the human mouth we are confronted with the *Leptothrix buccalis,* which has been said to be connected with the decay of teeth. Besides ringworm, there are also other skin diseases, both in man and animals, which are due to parasites. The *Acarus scabiei* produces itch in man, and other varieties of this arachnid afflict the dog, the sheep, the ox, and other animals.

This term "parasitism" has not, we believe, been extended to the many cases in which minute vegetable germs, or rather organisms, find their way into the blood and lymph-vessels, and the various tissues of different animals, by their vital activities bringing on disease and death; yet they are certainly very similar to those in which life is carried on by very lowly developed living things at the expense of the highest animals.

There is also to be mentioned another group of examples. Every species of animal is subject to the inroads of organisms belonging to the great class Vermes, and a peculiar point is that as a rule the worms which infest one animal are distinct from those which invade other animals; though in certain cases the same worm invades several, and even in some instances many, different kinds of creatures. Another and still more noteworthy feature is that many worms go through different phases of development, and that these phases are passed through in different animals. Indeed, the strangest of facts have been elicited by the students of Helminthology, facts which at first seem nothing less than startling. The life-history of these creatures is, in short, one of the most interesting of all topics of study. "Whether dealing with the external or internal forms," writes the illustrious helminthologist, the late Dr. T. Spencer Cobbold, "the study of parasites of man and animals is practically one of boundless extent; and there is probably no department of knowledge, possessing an equal value in relation to the welfare of man and beast, that is so thoroughly misunder-

stood by those who are directly concerned in the appreciation of its revelations." The tendency to change the place of abode is one which is especially curious in its manifestations, and it may be said that the study of parasitic worms opens up to our view the very strangest facts of which the human mind can take cognizance. Man himself, in spite of his unique position as the highest of the creatures of this world, is liable to be the host of a great variety of parasites, and there are certain species for whose propagation the existence of human beings is apparently an indispensable condition.

This is by no means a pleasing reflection, though it is to be remembered that we can by cleanliness and care in large measure obviate the dangers we incur. It has been very truly said that the amount of suffering which results from the presence of parasites within the interior of human beings bears a strict relation to the degree of barbarism shown in the choice of food and drink, and in the manner of eating and drinking.

The best known, and from many points of view most important, of the animal parasites which live within the bodies of other animals are known as "worms," and include round-worms, tape-worms, flukes, and many others. Those parasites which are known as "bots" represent the larval stages of various species of gad-fly, and belong to the Œstridæ, a rather numerous family of the class Insecta. "Bots" infest the stomachs of horses, and there is one called the *Gastrophilus rhinocerontis*, which is found in the stomachs of rhinoceroses both in India and Africa.

With regard to the entozoa generally, we may point out that they may belong to any one of the following six groups, viz.: Trematoda or flukes, Cestoda or tape-worms, Nematoda or round worms, Acanthocephala or thorn-headed worms, Arachnida, and, finally, Insecta.

We now proceed to consider some different groups of parasites. The Trematoda, or flukes, comprise six distinct families. They have their bodies provided with little holes or perforations called suckers, and the word fluke itself is of Saxon origin, and signifies anything flat. However, though some flukes, including the common liver-fluke, are flat, the members of many species of the order may be oval or even as round as a marble, or bi-convex or even filiform, while some may be so elongated as to resemble

the round worms, or nematodes, *e.g.* the bilharzia, which occurs chiefly in Egypt, where it causes a highly dangerous disease.

Of the trematode worms, which are found infesting ruminants, the most important is the *Fasciola hepatica* the well-known liver-fluke of those animals. Allied to it is the *Fasciola Jacksonii* of the elephant, and also the fluke found in the giraffe, These three kinds of flukes are said to be the only ones in which the intestinal canal is branched.

THE FLUKE DISEASE IN SHEEP.

Of all the disorders which now and again make their appearance among large numbers of sheep, perhaps the best known and most serious is that which is generally called sheep-rot, that justly dreaded scourge, which arises from the presence of flukes in the liver.

After long-continued wet weather, and more especially following upon a succession of wet seasons, the disease is particularly violent. We cannot here write exhaustively on this subject, since it is far more important as affecting sheep than any other class of animals; but, in view of the great value of knowledge regarding it, we propose to mention a few points. The mixing of salt with the food of sheep and cattle which are liable to the attacks of flukes has been strongly recommended as a preventive and curative agent; but the scattering of salt or lime upon the herbage is perhaps a still more potent preventive.

It is not long since Professor A. P. Thomas elucidated the subject by clearing up some doubtful points, and discovered that the intermediary stages of the fluke are passed in the snail known as the *Limnæus truncatulus.* It is possible that other snails may also serve the same purpose; but for the most part this particular snail is the creature in which the ova which are scattered about the land in the droppings of sheep or other animals infested with the flukes, such, for example, as hares and rabbits, must develop, before they can invade any other animal. In this connection it is of no small moment that we should bear in mind that man himself may be afflicted with liver-fluke, and that in such cases the cysts containing the young flukes may probably be taken in together with watercress, or in other ways. Hence watercress should always be steeped in salt and water, and thoroughly cleansed, before it is eaten.

The flukes are met with in the liver, and the sheep suffering from this complaint present a pale and anæmic appearance as a consequence of a deficiency of blood and general debility. The sheep should be kept on dry food, and plenty of rock salt should be at hand in small iron troughs, so that they can lick it. Indeed, we may administer one and a half ounces of common

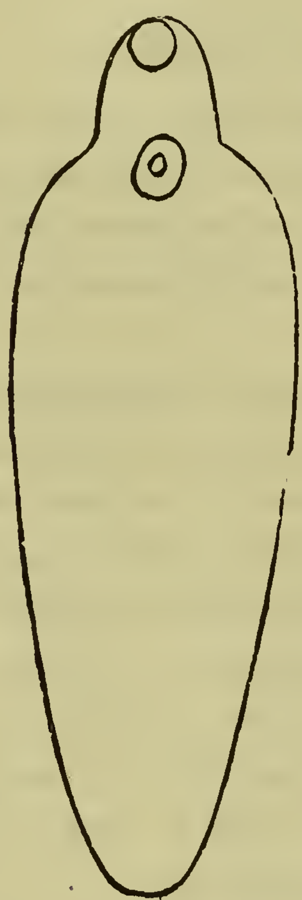


Fig. 57.*

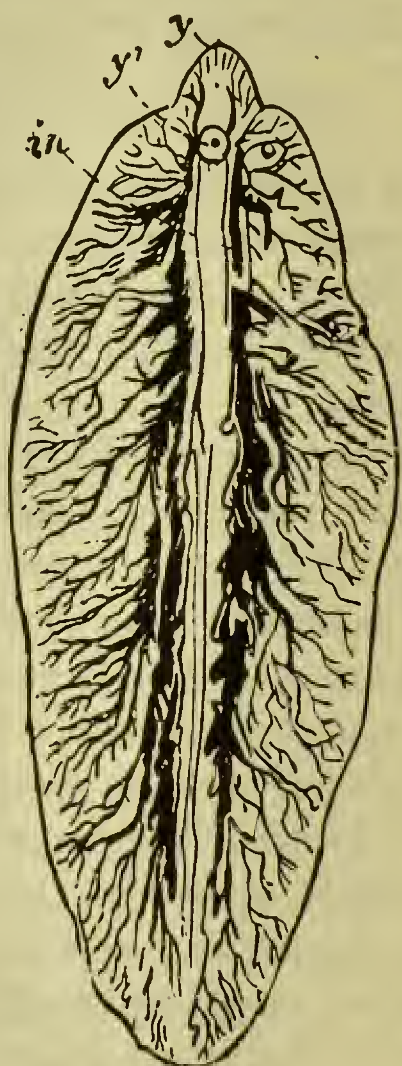


Fig. 58.

Fig. 57* (after Thomas) represents a specimen which has arrived at one-third of its full growth. In front the oral sucker is seen, and behind it the ventral sucker. The shape of the fluke is here seen, the animal being magnified so as to be about seven-and-a-half times its real size.

Fig. 58 (after Thomas) is magnified two diameters. It represents the digestive system. Y is the oral sucker, Y^1 the ventral sucker, In. the branched intestine.

salt, well mixed with three-quarters of a pint of water, for three or four mornings when the afflicted animals are fasting. The efficacy of this treatment was in one case exemplified by the fact that a sheep killed one week after this dose had been given was found to have 120 flukes, most of which were dead, in its liver. Again, it has been observed that sheep kept on salt-marshes are

never troubled with flukes. This may be due to the limnæus possibly not thriving in places where salt abounds in the soil.

Now the liver-fluke, known scientifically as the *Fasciola hepatica*, is a member of the large class Vermes, of the sub-class Sterelmintha, and it belongs to the order of Trematoda or flukes.

Now, the "Trematoda," or "flukes," as already said, are a group of worms embracing several different families, and they are possessed of either one or more suckers. The term "fluke" itself is of Saxon origin, and indicates flatness. Although, however, the ordinary liver-fluke is flat, the members composing many species of the order are round, bi-convex, or even filiform. The ordinary liver-fluke (*Fasciola hepatica*) is not usually more than an inch in length.

The digestive system is seen to consist of a short œsophagus from which the double and tree-like stomach branches into every part of the body, the ramifications terminating in blind extremities. The contents consist principally of bile which has been absorbed from the gall-ducts of the host.

This worm usually passes the adult stage of its existence in the liver, bile-ducts, or gall-bladder of a sheep, or of almost any ruminant, or of some one of certain other animals, of which we may mention the goat, argali, every variety of the common ox and zebu, zebra, two-humped camel, horse, ass, antelope, gazelle, red-deer, roe-deer, and the fallow deer, pig, hare, rabbit, squirrel, goose, pigeon, pheasant, poultry, great kangaroo, beaver, and man himself, in all of which it has been found, while a much larger but closely allied species, known as the *Fasciola gigantea*, infests the giraffe.

All these animals may suffer from the disease known as "rot," which is produced by the presence of flukes in the liver. The various phases of existence through which the worm passes are numerous and complicated.

It seems a startling statement to make, but it is nevertheless true, that a single fluke may produce half a million eggs, while each egg may give rise to 200 cercariæ; aud thus one fluke might, if every circumstance was favourable, yield 100 million flukes! Now, one sheep may be infested with a thousand flukes, and hence one sheep may give rise to one hundred thousand million flukes! In the season from 1830 to 1831 the estimated

number of deaths from sheep-rot was about one and a half million, worth perhaps as much as £4,000,000 sterling. Indeed, the average annual loss from sheep-rot has been said to be about one million. The number of sheep which were lost in the season 1879 to 1880 and in the succeeding season has been estimated in each case at about three millions. After long-continued wet weather, and more especially after a succession of wet seasons the disease is most markedly prevalent.

The liver-fluke is flat, of a pale brownish-yellow colour with a slight rose or pinkish tint; and when adult it is upwards of about one inch or even one and a half inch in length, and about half-an-inch from side to side in its widest part. When, however, the young creature first gains access to the liver, it is only about one-eightieth of an inch in length.

In sheep afflicted with the disease, the eggs occur in large numbers in the bile-ducts and gall-bladder, imparting a dark colour and a sandy appearance to the bile. It has been estimated that each adult fluke may produce as many as half a million eggs. Mixed with the bile they pass together with that fluid into the intestines, wherefrom they are at length expelled and distributed upon the ground together with the droppings. Provided that they meet with a suitable degree of warmth and moisture, these eggs will live, and inside each of those which meet with favourable conditions an embryo becomes developed, struggles out of the egg-covering, and swims about in any water which may be at hand, until it may perchance come into contact with the particular snail known scientifically as the *Limnæus truncatulus*, within which creature its further development must be proceeded with, if it is to go on at all. However, it is quite possible that certain other snails are, as we said above, also capable of acting this same part of intermediary bearer. The embryo is provided with a structure known as a head-papilla, which can be drawn in during the act of swimming, and can also be utilised as an effective boring-tool when the little creature happens to come in contact with its host. The embryo lives about eight hours in water, and then bores its way, possibly through the muscular foot, into the little snail known as the *Limnæus truncatulus*.

The embryo bores its way into the snail, and, having entered into it, undergoes certain changes, becoming, in the first place, a

sporocyst, which in its turn gives rise to about ten rediæ. These rediæ move about within the snail, and thereby cause so much disturbance that but very few snails live for many weeks after they have become infested. The next occurrence is that germs called cercariæ, tadpole-like little animals possessed of a flat oval body and a long slender tail, are formed within. Each cercaria is possessed of two suckers corresponding to those of the adult fluke. These cercariæ escape through a special opening, and then wriggle out of the snail, and swim about in the water, until

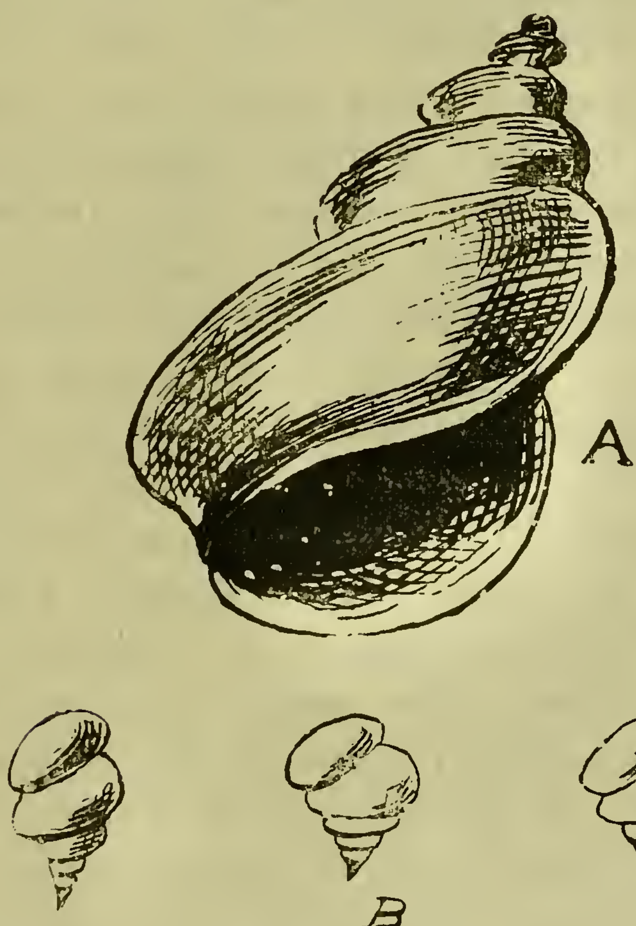


FIG. 59.—THE SHELL OF LIMNÆUS TRUNCATULUS.
A magnified, B a little larger than the natural size.

they come into contact with some plant or other solid substance. Then each comes to rest, attaching itself perhaps to a blade of grass or other similar substance, drawing up its body into the form of a round ball, exuding a gummy substance containing many granules, and throwing off its tail. The gummy substance hardens to form a snowy-white envelope or cyst, which is attached to the grass or other object near at hand. Unless it is then swallowed by a sheep or some other animal which is capable of becoming a host for the adult fluke, or even by a human being,

within a few weeks after its formation, the young fluke contained in the cyst will perish.

It is as well to mention here that infection with flukes may indeed occur at almost any age, but does not usually do so in animals less than three months old. When young lambs become affected, the eggs are probably taken in by their nibbling and playing with the grass.

Should the grass or other material to which the egg is attached be taken into the alimentary canal of some suitable animal, in about seven weeks' time the contents of the cyst will become developed into the full-grown liver-fluke. The little flukes, protected by their cysts attached to the grass, enter into the stomach, and, passing to the first portion of the small intestines called the duodenum, find their way into the liver, probably through the medium of the bile-ducts. Thus the encysted pupa at length finds it way into the liver, at first into the larger bile-ducts and gall-bladder, and after about seven weeks it arrives at full sexual maturity. Hence, if the pupa gains entrance into the body of a sheep during warm wet days in June or July, as is generally the case, no eggs appear in the droppings until August or September. The adult fluke may live in the body of a sheep one year, and possibly much longer. A sheep affected with liver-rot at first fattens quickly, the entrance of the young flukes into the biliary ducts acting as a local irritant and rendering the liver unusually active, so that a greater quantity of fat is produced and deposited in the tissues. However, on no account should sheep be put on pastures which are liable to give rise to sheep-rot. After a few weeks have elapsed, an infected sheep begins to shrink, the flukes having in that time grown so much as to impede the function of the liver. This organ secretes ineffective bile, and loses its power. The food which, in the process of digestion, flows from the stomach along the small intestine, is imperfectly acted upon by the imperfect bile, and the blood suffers in consequence. If the hips of a sheep infested with flukes are pressed, the sheep winces, and a peculiar crackling sound is occasioned. Again, if an eyelid of a sheep afflicted with sheep-rot be turned well back, and the blood-vessels of the white part and those of the haw be pale or yellowish in colour, then rot may be suspected. The skin of the sheep changes in hue from

vermilion to pale red. The wool is easily separable, and the skin becomes dry and dappled with yellow or black spots. The eyes lack lustre, the animal eats irregularly, grows gradually more and more thirsty, is irregular in regard to the action of the bowels, and may occasionally suffer from diarrhœa. The pendulous belly, the "razor back," the "hollow back," and a tottering gait, mark the later stages of the disease. The respirations are short and quick, and sometimes accompanied by a slight cough. The approach of death is heralded by dropsical swellings in different parts, as for instance under the chin. The pulse becomes quick and wavering, the animal lies down, refuses food, and dies from exhaustion brought on by general anæmia.

In sheep-rot, then, three stages are to be distinguished. In the early stage the affected animal is sluggish and averse to movement, when walking it walks slowly and with a measured tread, is thirsty and exhibits a voracious appetite, whereby flesh is gained and the sheep fattens. All these signs may continue for three or four weeks, and at the end of this period the skin becomes paler, and the mucous membranes also lose their natural colour. In the second or advanced stage the appetite fails, the gait is feeble, and the animals are unsteady and awkward in their movements. Moreover, pressure applied to the back causes pain. The skin and mucous membranes are blanched, and indeed present a deadly blanched hue. The conjunctival membrane becomes yellow, and the wool is capable of being easily torn off by the fingers. The third or final stage is characterised by a swelling under the jaw (whence the appellation "bottle-jaw"), by the belly being protuberant, the spinal column arched (whence the appellation "razor-backed"), by extreme emaciation, by diarrhœa, by the wool falling off, and at length by complete prostration, sinking, and death.

If the carcase be examined after death, it will be found that the liver is knotty and hard, and has a grating feel, which is due to the presence of calcareous particles and flukes' eggs. Here and there light yellow patches may be seen. The bile is thick, ropy, glutinous, and dark in colour, and it contains eggs. There may be present usually about sixty flukes, but even as many as 1,000 may be found. A sharp winter is injurious to the formation of slugs, and therefore to that of cercariæ and

flukes. Moisture being an essential for the development of the fluke, it is best to keep sheep on dry and well-drained ground, and low-lying farms especially should be thoroughly drained. Sheep which are folded are perhaps less frequently attacked than those at pasture, turnips not being so likely to harbour cercariæ. Sheep should be kept from stagnant ponds. Salines and especially common salt are highly beneficial by way of treatment. On no account whatsoever should the flesh of sheep in the final stage of sheep-rot be eaten.

Sheep-rot generally breaks out in districts where the soil and sub-soil are of a clayey nature, and where consequently there is little or no natural drainage. On the contrary, the disease is rare or absent in sandy, gravelly, or calcareous districts. The character of the soil seems to be of the first importance; for, according to Thomas, all fields upon the Oxford clay have been dangerous, whether exposed to floods or not, whereas floods on low porous grounds, or on gravel, appear to be innocuous in regard to sheep-rot, unless the water has remained stagnant for a long time.

After a very wet summer, rot is prevalent, water being necessary (together with a certain degree of warmth) for the growth of the larval fluke. If, however, floods occur, land which is badly drained and liable in ordinary seasons to develop rot in the sheep placed upon it, may become a veritable swamp, and consequently free from rot, since the cercariæ cannot become encysted where there is much water. On the other hand, land which is under ordinary circumstances well drained, and has been free from rot for years, may be a prolific source of the disease in very wet seasons. Ruminants are especially subject to rot, since the encysted cercariæ can remain in them without being destroyed for a long time in the first, second, and third, stomachs, whose secretions are not digestive. Further, sheep are especially liable to it, because they can graze so closely, closer in fact than any other quadruped except the kangaroo. The cysts become attached to stalks of grass near the damp roots, and hog-faced sheep which cannot crop close to the ground do not swallow the cysts, and hence do not become rotten. Again, lambs at Michaelmas graze more closely than ewes do, and are consequently more subject to rot than full-grown ewes and wethers. Salt kills the liver-fluke in every

stage of its varied existence, and also the *Limnæus truncatulus* which serves as intermediary host. The rot is unknown in salt-marshes, and where sheep feed on sea-weeds. Lime also kills the cercariæ, land well dressed with caustic lime or salt not being capable of producing sheep-rot. The months in which the eggs are first swallowed are May, June, and July, though the results may only be observed as late as September and October. The snail is buried in mud in the winter, the eggs being hatched perhaps in April, if the weather is warm, or more probably in May, June, or July.

If sheep graze for only a brief time on certain land, they may swallow the cysts with the herbage, and afterwards contract the rot. Great cold kills the fluke in its different stages, and it is said that one single night of frost may put a stop to the danger for the year.

When sheep are supposed to be infected, if the disease is in the first stage, they should be removed to a good dry pasture, and should be supplied with a dry, liberal, and nourishing diet. Good hay, beans, peas and a moderate allowance of oil-cake and turnips may be allowed, and it is well to change the food now and again. It is also advisable to give a quarter of an ounce of salt well mixed with half a pint of oats every day to sheep kept on a permanent pasture. Sheep so treated have been preserved, while others subjected to the same conditions in other respects, but not so treated, perished. The Bedouin Arabs allow infected sheep to feed upon the *salt-wort*, and Australians use the *salt-bush* for the same purpose. Good food strengthens the sheep, while salt kills the fluke, and also aids digestion.

Breeding ewes, however, must not have much salt. A useful formula is the following, which, we believe, is that of Professor Simonds :—

Finely-ground oilcake (linseed)	1 bushel.
,, ,, Pea meal	1 bushel.
,, ,, Salt	4 lbs.
,, ,, Aniseeds	4 lbs.
,, ,, Sulphate of iron	1 lb.

The salt, aniseeds, and sulphate of iron are to be first well mixed together, and then well mixed with the mixture of cake and pea-meal. Half a pint of the finally resulting mixture may be given to each animal daily, in addition to an ordinary allow-

ance of corn or cake and hay chaff. This treatment may be continued for three or four weeks, but should be now and again discontinued, especially if the animals suffer from diarrhœa.

If a sheep is becoming thin as a result of the disease, the best course is to send the animal to the butcher. If, however, fluke-disease occurs in a pedigree sheep, comfortable and warm quarters, plenty of dry food mashed with salt, and as little water as possible should be enjoined. One drachm of sulphate of iron together with half an ounce of salt well mixed with bran, oats and bruised cake may be given each day for a certain time, varying with the condition of the sheep. The adult flukes in about fifteen months die and pass away. When cured, the sheep will not do very well during summer grazing for perhaps a season or two.

It should be borne in mind that a sheep with "razor back," and "pendulous belly" cannot possibly be cured. Salt, *then*, is not only useless, but injurious.

With regard to preventive measures, drainage is the most important. As "a wet furrow, a springy spot, or the neighbourhood of a stagnant pool affords suitable hatching ground," these should be drained dry, so far as may be found practicable. Hedges and ditches should be kept in good order. Dressings of lime and salt on the land are most serviceable, since they will destroy the parasite itself, in all stages of its varied existence, and also the snail. Professor Thompson recommends a dressing of about 6½ cwt. of roughly ground rock salt per acre in the month of March, April, or May. The time chosen for the dressing should be, if possible, when the water has subsided from flooded land. Sometimes it may be more practicable to strew layers of lime or salt along the margins of ditches or streams. Great care should be taken that the droppings of rotten sheep should never gain access to moist lands. The droppings should, if practicable, be buried with antiseptic precautions.

Livers in which the flukes have taken up their abode should be destroyed after being removed from the body, or at any rate they should be very well boiled, if it is intended to give them to dogs, before doing so.

The *Limnæus pereger* may also act as a host for the embryo fluke, and it is at least very possible that other snails also may

likewise serve that same purpose. The liver-fluke occurs both in the United States of America and in Australia, notwithstanding that the *Limnæus truncatulus* has not been found, and is probably not present, in either of those countries. Hence we cannot but think it probable that other snails, and possibly also slugs, may act as intermediary hosts.

It will clearly be seen, then, that one sheep cannot directly take the disease from another sheep, and it seems also that one snail cannot be directly infected by another snail. We must also bear in mind that hares and rabbits, as well as cattle and sheep, distribute the eggs of flukes far and wide, and that they also may be conveyed by manure, by the feet of men and dogs, and by running brooks. The snails also, after they have been infected, are doubtless also largely distributed by rivulets, rivers, or floods.

Sheep afflicted with this disorder ought not to be kept on damp ground, because the eggs need moisture in order to maintain their vitality, and hence have not the same chance of living if they fall on dry soil. For this same reason all damp pastures ought to be thoroughly drained, so that there may be no collections of stagnant water in which the eggs can retain their life.

It is of especial importance that all land should be well-drained, and that the practice of fattening sheep on pastures liable to cause sheep rot should be at once discarded. It seems that Lord Penrhyn, in 1881, had not had a case of sheep-rot for fifteen years, and this he attributed to the keeping his sheep off wet land, his dykes well dug out, his land thoroughly drained, to the providing of good hay for the winter, to salting the hay when ricked, and to having rock-salt within the reach of the sheep. Moreover, salt or lime should be scattered on the herbage in pastures on which it is suspected that the disease may break out. If the land be thus dressed with lime or salt, the snails will be in some measure destroyed. These useful substances should therefore be especially scattered about along the courses of brooks, and by the sides of ponds and ditches, and on or near any marshy places. More particularly should flooded lands be dressed, since a flood after subsidence may leave snails scattered broadcast.

The mixing of salt with the food of sheep and cattle which

are liable to the attacks of flukes has been strongly recommended as a preventive and curative agent. Salt should be given together with dry food, but great care must be taken in the case of breeding ewes that they do not get too much. The experiment was tried by a Mr. Heath of giving to some sheep which were feeding upon permanent pastures one quarter of an ounce of common salt, well mixed with half-a-pint of oats every day. Those which were thus fed had no flukes, while those which were not treated in this way were afflicted with the worms.

So far as may be possible, the eggs of the liver-fluke should be destroyed, while the manure obtained from any animal which is affected should never be put on wet ground. As a general rule, all sheep which are infected should be sent to the butcher at once; but if they are very valuable and very slightly diseased, they may be isolated and put under treatment, and placed upon high and dry pastures. All heavy or wet ground ought to be thoroughly drained. Indeed, the paramount necessity of good drainage cannot be too strongly insisted upon, since imperfect drainage, coupled with general inattention to sanitary measures, is the source of many different diseases, both of men and animals.

Dressings of lime or salt should be spread over the ground at the proper seasons, for the purpose of destroying the embryoes, the cysts of the fluke, and also the snail. Sheep should not be allowed to graze closely, the fluke germs being usually situated near the ground. When sheep are allowed to graze on dangerous ground, they should have a daily allowance of salt mixed with a little dry food.—(A. P. Thomas.)

OTHER PARASITES FOUND IN RUMINANTS.

Another Trematode worm, *Distoma lanceolatum* (or lancet-shaped fluke) by name, not only infests the liver-ducts of cattle and sheep, but also those of the deer tribe. This fluke is soft and transparent, and its length is about one-third to three-eighths of an inch, while its breadth varies from about one-twelfth to one-sixth of an inch. The parasite is, in fact, so small that it works very little mischief, although it is often found together with the *Fasciola hepatica* in the liver ducts.

Three instances of the presence of this parasite in human beings have been recorded, one being that of a young girl

who swallowed water taken from a stagnant pond which contained the larvæ.

Next comes the *Amphistoma conicum*, a Trematode still more commonly met with. It is provided with a large sucker at its posterior part. It is half an inch long and a quarter of an inch broad. Its eggs are 1·150 inch in diameter. This parasite infests the paunch or first stomach of oxen and sheep, and it is also found in goats and antelopes. The *Amphistoma crumeniferum* is found in the paunch of Indian cattle. The intestinal canal of this parasite has its orifice just underneath the mouth. The *A. explanatum* is found in the liver-ducts of the zebra. The *A. tuberculatum* is so called because it possesses numerous tubercles on the surface of the body. It is found in the large intestine of the ox in India. The *Bilharzia bovis* and the *B. ovis* are very much like the one found in human beings, but are a little longer than it. The eggs differ in that they are spindle-shaped.

The *Pentastoma tænioides* found in the mesenteric glands of the sheep is born of the eggs of a parasite of the dog which are gathered up by the sheep in their food. Should a dog or wolf devour the entrails of animals in whose glands the parasites exist, the embryoes may adhere to the lips and nose, and then find their way into the nasal cavities. They pass up the nose rapidly, and fix themselves by means of their hooks. In less than two months their generative organs are developed. They remain for a year in the nose of the dog before attaining full development.

The next group of parasitic worms which demands attention is that which goes by the name of the Cestoda, or tapeworms, though under this designation the worms known as "measles" * and other bladder-worms, or hydatids, are included, as well as adult tapeworms. The Greek word *kestos* means a band or girdle, and this order has acquired this name of Cestoda from the fact that most species in the adult condition resemble a tape or band, from which similarity also arose the name tapeworm. In these worms there is neither mouth, stomach, nor anything resembling an alimentary canal, and the creature therefore derives its nutriment by a process of what is called *osmosis*, or imbibition. A tapeworm's head is very small indeed. It con-

* These so-called "measles" have nothing whatever to do with the infectious fever called "measles."

stitutes the first segment, and after it come the generative segments, which are called "proglottides," which are produced by a process of budding from the head. The youngest segments are narrow and soft, and compose the "neck," or part nearest to the "head," and those which are farthest away from it are the most mature. In fact, as we pass from the head, the segments gradually become broader and longer, and more distinct from one another. The hindmost segments are the largest, possess the power of separating themselves, and that of leading for a short time an independent life. They escape from the body, the ripe eggs with their hard shells retaining their vitality, and their readiness to undergo a series of changes which culminate in the adult tapeworm. If all the rest of the worm be removed, the head alone being left, the whole creature will again be gradually reproduced.

Hence it is very difficult to remove a tapeworm when it has once taken up its position in the interior of a man or animal. Those who have the grievous misfortune to be afflicted with a tapeworm well know the immense inconvenience occasioned by the entozoön, and the tenacity of its existence, and the physician knows only too well how difficult it is to cause the expulsion of the little head. This is, in the case of some tapeworms, of about the size of a pin's head, and when it is magnified, its sides are seen to be provided with four "suckers," by means of which it fastens itself to the wall of some part of the alimentary canal. In addition to these sucking discs, some tapeworms are possessed of circles of hooks placed in front of the suckers. These hooks have sharp projecting points, which serve as anchors for the tapeworm.

The tapeworms of the ox may be as much as 50 ft. or even 100 ft. long; but that of the cat is very much shorter. The head of some tapeworms is provided with hooks, while that of others is devoid of hooks, *e.g.* the head of the tapeworm of the sheep, and also that of the ox, have no hooks. There are six different kinds of tapeworms met with in animals. To one of these divisions the name Tetrarhynchidæ is given. Examples are found in the sun-fish. They are provided with numerous spines on the head, and by means of these they tunnel about in the body of their host. Sometimes the liver of the sun-fish is simply nothing more than a bag full of these worms.

A tapeworm may be said to be a cestode form of a colony of zooids arranged in single file, the topmost zooid being the so-called head or nurse. The worm may take three months to arrive at its full size, and at about that age the *Tænia mediocanellata* consists of as many as 1,200 zooids joined together. When this number is attained, the last zooid falls off, then the next, and so on, about eight of them being expelled with the feces each day that comes. A person infested by one of these tapeworms passes 1,200 zooids four times in each year. Now, each zooid contains 35,000 eggs, and hence 168 million eggs are distributed in one year. We need not, then, be very much surprised to hear that in one case a single pound of psoas muscle taken from a beast in India was found to contain 300 larval forms, and consequently we shall observe that beef as well as pork should always be most thoroughly cooked.

We now proceed to consider those Cestodes which have been found in young ruminants. There are not many tapeworms which are known to infest ruminants. Cattle are liable to harbour the *Tænia expansa,* and also the *Tænia denticulata*, the former of which is more or less prevalent in sheep, antelopes, and deer. Large numbers of lambs perish as a result of the presence of tapeworms (*Tænia expansa*), and the loss in Australia from this cause is especially great.

The latter occurs also in the ox, gazelle, chamois, and other animals. It seems that this tapeworm frequently attacks sheep which are kept on overstocked land, and for this reason, as well as for many others, it is advisable that only a sufficient number of these animals should be kept together. The head of this tapeworm, the *Tænia expansa*, is unarmed and provided with four suckers. The animal is made up of the enormous number of 7,000 segments which are broader than they are long. Each segment is provided with two reproductive papillæ on either side, and each is a double hermaphrodite. These tapeworms, in the case of the ox, have been known to measure as much as 100 ft. in length, but they are usually about 40 or 50 ft. long. In lambs they vary in length from 1 to about 7 or 8 ft. in length. They infest the intestinal canal.

As yet the source and life-history of these tapeworms do not appear to have been determined, but possibly the larvæ may exist in the ox-louse or in some other insect, for it may be taken

as a general rule that the larvæ of those tapeworms which have thin-walled eggs are usually developed in insects, while those which have thick-shelled eggs usually pass their larval stages in flesh, the reason being that the somewhat weak secretions of insects are only capable of dissolving a thin covering, while, on the other hand, the stronger secretions of the higher animals can cope with a stronger covering.

No epizoöty or fatal results due to this parasite have been heard of as affecting cattle. Among lambs, on the other hand, this tapeworm sometimes brings about a great many deaths. The lambs lose their appetite, and waste—suffer from diarrhœa, and die. After death the tapeworms are found, sometimes in rather large numbers, especially in the large intestine. In regard to treatment, equal parts may be taken of tincture of asafœtida, of oil of turpentine, and of linseed oil. The dose of the mixture for lambs is about half a fluid ounce. Instead of the tincture of asafœtida, oil of filix-mas may be substituted. The dose of the solid filix-mas for a lamb is about one or two drachms. An aperient dose should be given of about one ounce of Epsom salts before the filix-mas. Turpentine given in doses of one drachm in thick linseed tea, linseed oil, or gruel may be useful.

Next in order we come to the consideration of the *Tænia denticulata*. This tapeworm varies in length from 8 to 10 inches, and in breadth from ½ to 1 inch. The head is square, and is not provided either with hooks or with proboscis. The structure is like that of the *Tænia expansa*, but the edges are more distinctly serrated, and thus we can easily distinguish between the two kinds.

The *Tænia alba* is found in the sheep of Italy. The egg-capsules of this tapeworm are square-shaped and very thick and strong. These tapeworms may attain the length of three yards. The *Tænia resterna* is very short.

However, ruminants suffer far more severely from bladder-worms, such as the *Echinococcus veterinorum*, the *Cysticercus tenuicollis*, and the *Cœnurus cerebralis*, which infest all varieties of cattle, sheep, and goats, the deer tribe, antelopes, the giraffe, and camels. Cattle are also very liable to harbour measles (*Cysticercus bovis*), and sheep are troubled with the armed *Cysticercus ovis*.

The bladder-worms of ruminants, also included under the head

of Cestoda, are as follows :—The *Cysticercus bovis* is a monocephalous bladder-worm found in the muscles, aponeurotic tissues, and some of the viscera of the ox. The head is square, and it is provided with four large suckers, and an additional depression in the centre. This cysticercus differs from that of the pig, the pork measle, in that the head is not armed, and that the suckers are larger. The length is about ¼ in. to ½ in., and in exceptional cases 1 in. A half-pound of psoas muscle in one case was found to contain 150 cysticerci. The *Cysticercus bovis* is the larval form of the *Tænia mediocanellata* of man. These measles undergo calcareous degeneration very quickly, and are destroyed in about six months. The *Cysticercus ovis*, or mutton-measle, has been found in mutton on five occasions, and the rather small tapeworm of man, which may be derived from eating mutton, is called the *Tænia tenella*. The *Cysticercus cellulosæ*, or pork measle, gives rise to the *Tænia solium* of man.

The *Cysticercus tenuicollis*, or slender-necked hydatid, varies in size, and may be as large as a cricket-ball. The head is provided with four suckers. This hydatid is the larval form of the *Tænia marginata* of the dog, and it infests especially sheep, cattle, deer, and swine. The *Cysticercus fistularis* of the hog is a long bladder-worm, and supposed to be merely a variety of this *Cysticercus tenuicollis* of the sheep. The *Echinococcus veterinorum* is the larval form of the *Tænia echinococcus* of the dog. It may infest the vital organs of sheep, swine, cattle, horses, and even man. When present in the brain of sheep, it does not cause symptoms as severe as those of sturdy, and probably the reason of this is that the heads of the echinococcus do not protrude from the cyst, whereas those of the *Cœnurus cerebralis* do protrude. The two hydatids are alike in the fact that the eggs of each come from a particular kind of tapeworm, which infests the intestines of the dog, the *Tænia cœnurus*, and the *Tænia echinococcus* respectively. Larval cestodes have apparently not been found in the elephant.

Gid or sturdy in sheep is due to the presence of a cyst called the *Cœnurus cerebralis* in the brain. It is a very instructive sight to see this cyst, and our readers may observe it for themselves in many museums. This disease is commonly met with in all parts of the United Kingdom among sheep. In some

districts there may be an annual loss due to this cause of about $7\frac{1}{2}$ per cent. among yearling sheep. In fact, the malady is rarely met with in sheep above two years old, and it usually affects lambs which are under one year of age, and only rarely occurs in sheep over eighteen months old. It is said to be more frequently met with in the case of some breeds, such as the Cheviots, than in that of others, and particularly in the autumn and winter it afflicts animals which are already enfeebled. In some districts, however, it apparently breaks out most especially in the summer time, provided that the sheep are kept upon unenclosed pastures, where the flocks are constantly under the guardianship of shepherds aided by dogs, or on farms where sheep are fed to a great extent on turnips, being confined within short limits, and having one or more dogs among them.

The *Cœnurus cerebralis*, the larval form of the *Tænia cœnurus* of the dog, is the hydatid which gives rise to the disorder known as gid in the sheep. It has also been found in the goat and in the ox. Only one instance of it being found in the horse has been recorded. This hydatid varies in size from that of a pea to much larger than a pigeon's egg, and it is like a bladder provided with spots, which in reality are retractile heads, each of which is furnished with hooks and suckers. A single bladder may have from three to five hundred heads. The vesicle is full of a pale fluid, and its walls consists of three layers. As it increases in size, it presses more and more on the walls of the skull, and in consequence of this the cranial bones become so thin and soft that they can easily be found and pierced, especially as they may probably yield in some degree to the force exerted from within by the gradually enlarging cyst.

Formerly, sturdy was thought to be due to a fly perforating the skulls of sheep and laying its egg or eggs in the brain. It is now, however, well known that this disease is occasioned by the eggs of the tapeworm infesting a dog being taken up by the sheep from the ground, and by their getting into the blood and finding a favourable place of development in the brain of a lamb or sheep. The eggs are distributed on the ground by dogs afflicted with the tapeworm called the *Tænia cœnurus*. Dogs which have eaten the hydatids taken from the brains of sheep afflicted with sturdy soon develop large numbers of tæniæ, and on giving the joints which were deposited by dogs thus treated

to lambs, the latter suffered from gid. In one experiment it was found that even a fourth part of one hydatid of a sheep led to the development of one hundred and ninety-one tapeworms in a dog. These tapeworms grow so as to be one line or two in length in less than a fortnight; by the third week they become an inch long, by the fourth week about four inches long, and finally, at the close of the third month, they may be about two and a quarter feet long. These tapeworms remain in the small intestines of the dog; but when they are about to be expelled in part, they extend, of course, into the large intestine.

One of the chief points about them is that they are liberated in separate portions called segments or proglottides, each one of which is charged with many hundred eggs. Hence it will be readily seen that the risk of some of the eggs being swallowed by sheep is very greatly intensified by the fact that a dog may distribute these joints in many different parts of a field. By way of experiment, proglottides of this tapeworm were given to thirty-nine sheep and two calves, with the result that twenty-two became affected with sturdy. Naturally, we should not suppose that all would take the disease, since in some cases the eggs would perhaps pass harmlessly along the course of the digestive canal without any deleterious effect whatsoever. Moreover, the joints or segments must be mature, in order to produce any effect.

In the cases we are speaking of, the symptoms were manifested from about a week to about four months after the proglottides had been swallowed. The number of cœnuri found in the brain varied from four to about two hundred, and they were as a rule distributed throughout the brain. It is noteworthy, too, that the cysts are frequently found in the muscular tissue, and especially in that of the œsophagus, intestines, diaphragm, and heart. As is very evident, the symptoms displayed by sheep afflicted with the malady entirely depend upon the number and position of the hydatids in the brain.

It is manifest that the effects on the nervous system of the animal must be dependent on the number, size, and position of the cysts. In the early stages the disease may be only very slightly observable. The afflicted sheep has a dull appearance, turns round and round, and often falls down, will not graze,

stands apart from the rest of the flock, and often near water, loses flesh, becomes emaciated, staggers in its walk, shows signs of partial paralysis, for example by its awkward gait, the back is stiff, the pupils of the eyes are dilated, the conjunctiva has a bluish tinge, and the eyeball itself is prominent. The sheep may become quite blind, entirely lose its appetite, be altogether unable to follow the flock, run up against trees, walls, or other obstacles, and frequently turn round, usually in one direction, and frequently towards the side opposite to that of the hemisphere which is affected, for example to the right, if the hydatid is situated on the left side, and *vice versa*. Moreover, if the cyst lies between the two cerebral hemispheres, in the middle line, so as in fact to correspond with a line passing through the centre of the forehead, the animal will move more or less persistently forwards in a straight direction, and run against a wall or fence, or perhaps fall into a pond or ditch or river, as the case may be, and be totally devoid of the power of extricating itself from its perilous position.

Again, in case the cyst is located in the cerebellum, the sheep will lose control over the voluntary muscles and the limbs, which will probably be lifted up in a peculiar, jerking kind of way, and then put down again in an uncertain manner and without precision and accuracy. In fact the animal may be observed to advance with its head raised, and with a hesitating movement of all its legs, and a special inability to lift up its fore-limbs. Consequently the poor creature, in its bewilderment and dismay, will probably try to advance by a succession of leaps; but this device only leads to it falling down in helpless incapacity, and then to vain struggles and efforts to rise up again, and rollings on its side. Moreover, in some cases, cysts may be present on both sides of the brain, and if this is the case, the sheep thus afflicted may turn now to the right side, now to the left. Of course, in proportion to the growth of the hydatid, the number of heads augments, the malady becomes more severe, the attacks of giddiness and the running round and round in circles become more extremely marked and more frequent, the rapidity of the movements increases, and at length the animal becomes completely paralysed, and can no longer even stand.

As for the cyst itself, it is in reality a bladder which is provided with a variable number of exsertile heads, and, according

to Dr. Davaine, the brain may be excited by the heads, which protrude from the bladder, and penetrate the adjoining substance of the brain to a depth of about two lines. Thus it is as if one or two hundred pin-points were plunged into the brain. As is to be expected, the animal becomes weak, and, unless it is by some means relieved, at length it dies. It is said that a natural cure has in certain cases been brought about by means of the sheep striking its head against a sharp stone, and thus cutting open the head, whereby the cyst can escape through the aperture which is formed.

With regard to diagnosis, it may be remarked that sturdy may occasionally be mistaken for disorder of the brain resulting from impaction of the third stomach. This disorder, however, is, as probably our readers know, of an acute character, and marked by constipation, delirium, convulsions, and early death, unless, indeed, relief is obtained by means of the effectual administration of a brisk purgative. Again, sturdy might possibly also be confused with the presence of the maggots of the sheep-bot, which lodge themselves in the frontal sinuses, produce much irritation, swelling of the pituitary membrane, and discharge from the nose. If these maggots are very successful in their aggressions, the sheep becomes dull and prostrate, and may die in convulsions.

In most cases the best plan is straightway to send sheep which are afflicted with gid to the butcher. If, however, we should decide to treat the animal, bags of ice may be applied constantly to that part of the head where the cyst is situated. Moreover, a portion of the wall of the skull above the cyst may be removed, the correct spot being found by feeling for a soft part. The bladder can then be seen, and the fluid contained in it may be allowed to escape. Some shepherds find the soft part, then pierce through the skull with a borer, then place the sheep on its back, holding the animal so that it cannot struggle while the fluid is pouring out, or while it is drawn off through a cannula by means of a syringe. If it is possible to do so, they also take hold of the membrane, and withdraw it carefully.

When the wall of the cyst is examined, 200 or more little elevations like pin-heads may be seen projecting from its inner surface. Each of these really represents the head of a possible

future tapeworm, and provided that it be swallowed by a dog, it is capable of being converted into a tapeworm in that animal's intestinal canal. If the above operation has been performed, the wound should be covered with a pitch plaster and a leathern hood, and the sheep ought to be kept in a dark, quiet, and secluded little shed, and fed for the space of a week on soft and laxative food.

In view of the possibility of any sheeps' heads containing hydatids, they should not be given to dogs as food unless they have been first subjected to the process of being thoroughly boiled; and, moreover, sheep should never be allowed to graze or feed on land whereon the segments of tapeworms will most probably be lying, if a dog or dogs harbouring a tapeworm or tapeworms has access thereto.

The name Thorter Ill has been given to another kind of nervous disorder, which is due to the presence of an hydatid in the cervical portion of the spinal cord, whereby more or less marked paralysis of one or both sides of the body may be occasioned.

The Nematoda, or *Order of Thread-worms and Round-worms*, comprise not only lumbricoid, or round, worms, properly so called, but also thread-worms. The term derives its origin from the Greek word *nema*, which means a thread. Of the nematodes or round worms, some are very small, some parasitic, and some free. Those which are free are very minute, and they are found in moss and in water. Some are semi-parasitic, as for instance those which live in the slime on the backs of slugs. There are ten groups of nematodes. Of these we may mention the ascaridæ, a large family comprising divers forms which infest most of our domesticated animals. The males are provided with two equal spicules projecting from the tail. The ascaris lumbricoides is said to have been found in cattle. The length of the males varies from about 4 to 6 inches, whilst that of the females varies from about 4 to 14 inches. The cucullanidæ are provided with large cup-shaped muscular mouths, and infest fishes. The strongylidæ infest several of our domesticated animals—*e.g.* horse, pig, and sheep. The *strongyles* come under this group. The term *strongulos* means round or cylindrical. To this order belongs, therefore, the worm known as the *Strongylus micrurus*, of which we have spoken as being

the cause of Husk or Hoose in cattle, and the *Strongylus filaria*, which attacks sheep and especially lambs. There can be little doubt that the young of the strongyles, which occasion verminous bronchitis of calves and lambs, undergo their primary changes of development either within soft mud alone, or within the bodies of earthworms or small slugs or insects, and other minute creatures among the herbage, or possibly within the bodies of larval insects or other animals inhabiting ponds, ditches, and streams. Some of these strongyles live within the bodies of animals, some in the slime of animals, some infest plants, while some are entirely free. Some of those which live in the interior of animals lead a free life in their larval state, passing a certain grade of development in mud and water, while some pass through certain larval changes of growth within the bodies of insects and other creatures. Several other strongyles infest the sheep, the ox, the goat, and stag. The strongyles, of ruminants include the *Strongylus micrurus*, the *S. filaria*, and the *S. rufescens*. The *S. hypostonus* infests especially the intestines of the sheep. The larvæ of this strongyle, which are rod-shaped, live in mud. The *S. cernuus* is nearly one inch in length. This worm may infest the intestines of the sheep in large numbers. The *S. filicollis*, or slender-necked strongyle, is met with in the small intestines of sheep, and especially in those of the lamb. The *S. contortus*, or twisted strongyle, may be present in the abomasum or fourth stomach of the sheep and lamb, and in the goat, usually together with the *S. filaria*.

The *S. radiatus* resembles the *S. cernuus*. This worm infests the gall-ducts and the first portion of the small intestine (called the duodenum) of young cattle, and it gives rise to a fatal epizoöty among young oxen. The *S. inflatus* infests the large intestines (the colon) of the ox. The *S. ventriculosus*, or swollen strongyle, infests the small intestines of the ox. The male *S. gigas* is twelve inches long, while the females may be upwards of three feet in length. The *S. venulosus*, or veined strongyle, is rarely met with. It has been found in the small intestines of a goat. The females are three-quarters of an inch in length, the males half an inch long. The trichinidæ are very minute, the mature male being one-eighteenth of an inch in length, and the mature female one-eighth of an inch long.

The *trichina spiralis* has been reared in the goat and calf. This worm has been found in man, pig, ox, rabbit, rat, and other animals. The oxyuridæ, or thread-worms, may be mentioned, and as an example of them the *Oxyuris vermicularis* of children and the *Oxyuris curvula* of the horse. The female oxyuris has a sharp-pointed tail; but the tail of the male is blunt and curved upwards. The trichocephalidæ may also be mentioned as members of the group Nematoda. The head and neck of these worms are thread-like, and the body, being flat, presents somewhat the appearance of the handle of a whip. These so-called whip-worms are sometimes fatal to lambs. Both the male and the female *Trichocephalus affinis*, or whip-worm of ruminants, are two inches long. It infests the large and small intestines, and especially the cœcum of the sheep and goat, and rarely of the ox, and gives rise to irritation. Turpentine is said to be very useful in regard to cure.

We may also mention that the *Trichocephalus affinis* probably infests all ruminating animals. Moreover, the eyes of cattle are occasionally infested with the *Filaria lachrymalis* and the *Filaria papillosa*, which last is the common eye-worm of the horse. Indeed, the *Filaria papillosa*, or eye-worm, has been found in the horse, ox, and ass. Only two cases of its occurrence in the ox have been recorded. It is found in the globe of the eye, usually in a cyst within the cornea, also in the peritoneal and thoracic cavities, in the diaphragm and abdominal muscles, and in the arachnoid membrane of the brain.

Leaving now the worms for the purpose of turning to the external parasites, we have the mange-mite of the ox, which is called the *Chorioptes spathiferus*. Ruminants are annoyed by many insects, including flies, fleas and lice. The *Hypoderma bovis*, whose larvæ form warbles on the back, has been already described, while the larvæ of the *Cephenomyia bovis* reside at the root of the tongue and neighbouring parts.

The tsetse-fly (*Glossina morsitans*) has been immortalised by Livingstone. It is one of the worst of the free parasites which attack ruminants. The *Rhagio columbaschensis* is a fly which proves fearfully destructive to cattle in Hungary and Servia. As regards the lice, *Hæmatopinus vituli* of the calf, *H. eurysternus* of cattle, and also the *Trichodectes scalaris* of the ox, should be mentioned.

We now proceed to deal with the *Œstrus ovis*, or sheep-bot. In the first place we may say that it is in the hot and sultry days of July and August that the bot-fly of the sheep pursues its timid and well-nigh defenceless victim. During the heat of the summer's day, and especially when the atmosphere threatens a thunderstorm, the insect is particularly busy in its attempts to deposit its eggs in the nostrils of the sheep. After the time of its activity is over, the fly may easily be caught and examined. It is a member of the tribe of two-winged insects, and it is a little larger than the ordinary house-fly, and of an ashy grey colour.

The sight of a flock of sheep being attacked by this fly is a very instructive one. The sheep themselves seem to be quite cognisant of the danger which threatens them. They may hold their heads between their fore-legs quite close to the ground, so that the fly may not be able to approach their nostrils, or perhaps a sheep may be observed lying in a deep rut or hollow with its nose in part protected. Moreover, it appears that the presence of dust affords some safeguard against the pest, and hence we find as a matter of fact that the tormented animals will instinctively resort to a dusty road in order to escape, or, again, they may rush to form a more or less compact assemblage with their noses pushed closely together so as to foil, at least so far as the greater number of the sheep are concerned, the persistent and insidious efforts of their insignificant foe. It seems probable that great pain is occasioned by the entry of the fly, and the laying of the eggs.

As we have said above, it is usually in July or the early part of August that the fly deposits its eggs, which are soon afterwards hatched. The maggots which are set free crawl up the nasal cavity by the help of the hooks with which their mouths are provided. When once they have gained a position of comparative security, they then fix themselves tightly to the membranes, feed upon the pus which is poured out as a consequence of the irritation produced by their presence, or even upon the nasal membrane itself. Occasionally they may actually penetrate to the brain, and even death may result from the effects of their inroads. In the general way, they remain in the higher parts of the nasal cavity until the spring-time, when they are full-grown. Then they fall to the ground, and become pupæ. During the

summer, the pupa-case opens and the fly is set free, and then proceeds, just as its progenitor did, to lay its eggs in the nostrils of its victim, after which it perishes in due course in the autumn.

With regard to treatment, it is advisable to place the sheep which are afflicted in a warm building, with the view of tempting the grub to make its escape from the nasal sinuses. Snuff, solution of common salt, infusion of tobacco, diluted vinegar, or weak solution of turpentine, may then be introduced into the nose, in order that the maggots may be removed by the sneezing which is caused by reason of the irritation set up by their presence. In order to remove those maggots which remain in the sinuses, the best plan is to trephine the bones of the face between the front of the eye and the middle line of the face, or, if the sheep be possessed of horns, in front of the root of one. The sinus should then be well syringed out with tepid water, containing a small proportion of carbolic acid, until the noisome parasites are quite washed out. Some have recommended that the faces of the sheep of a flock should be smeared over with a mild antiseptic ointment, such as that of carbolic acid, every few days in July; and also that the ground should be ploughed, in order that the creatures may be buried while yet in the pupa state. The former of these two suggestions is practicable, but the latter would obviously be quite impossible in many cases, and would be quite useless, unless it were carried out on a very large scale.

SECTION V.
DISEASES OF THE ALIMENTARY SYSTEM.

DISEASES OF THE MOUTH AND TONGUE—ACUTE TYMPANITES, HOVEN.

We now proceed to deal seriatim with the diseases of the digestive organs, and with the prevention of them.

It is our purpose to commence our review of the diseases on the alimentary organs of the ox, with a consideration of the common derangements met with in the mouth and tongue, and

we shall, in the first instance, draw the attention of our readers to the malady known as thrush and also as aphtha.

By the term "thrush," or "aphtha," we understand a condition characterised by the appearance in the mouth of a number of small vesicles or tiny bladders containing a clear fluid. The usual seats of these elevations are the inner surfaces of the cheeks and the surface of the tongue. The mouth is very sore, and the animal has difficulty in masticating hard food, and swallows not without pain. The vesicles soon burst, leaving little ulcerated patches in various places. The tongue is often swollen, and saliva is discharged from the mouth, which is hot and inflamed.

As a rule thrush is not a serious disease, being speedily over; yet in some instances the vesicles are more widespread, invading the gullet and even the stomach and intestines. In such instances there is much prostration, and death may ensue. As in the human species, young animals, especially sucking calves, are often attacked. Our readers will understand that thrush bears no relationship with foot-and-mouth disease, which is termed aphtha-epizoötica. We have already discussed the nature and cause of the latter plague, and we may here mention that thrush, though commonly depending upon digestive disturbance as its chief cause, has in some instances been shown to be caused by the growth of a fungus termed the Oidium Albicans, which spreads in whitish patches on the cheeks, tongue, and lips. Thrush in a mild form is especially common in young cattle and lambs during the teething time. In ordinary cases of thrush, a gentle aperient should be given, and a gargle of chlorate of potassium (fifteen grains to each ounce of water) should be used for the mouth twice or three times daily; or, if preferred, a gargle of alum (fifteen grains to each ounce of water) may be substituted. The diet should be laxative, and no hard food should be allowed. In very severe cases, carbonate of ammonium and other stimulant remedies are necessary, in order to combat the severe prostration.

Concerning the diseases of the tongue of the ox we shall not have much to say, for we have, under the heading of Actinomycosis, already discussed in detail this by far the most important and most serious of all diseases of this organ, and so we shall proceed at once to the consideration of hoven. Of paralysis of

the tongue in the ox, we need not speak, as, whether due to injury or to disease of the brain, it necessitates slaughter.

Acute Tympanites.

Acute tympanites, generally known as "hove," "hoove," or "hoven," and also as "blown," "dew-blown," "fog-sickness," and also under some other appellations, is a very important disease in cattle and also in sheep. Indeed, this disorder is liable to present itself among sheep in a severer form, though perhaps not quite so frequently as in oxen. The disturbance resulting from the accumulation of food in the rumen and of gases disengaged from it may be so great that even asphyxia may be brought about in consequence of the pressure of the stomach on the lungs by the medium of the diaphragm.

It is especially important for three reasons. Firstly, it is very common—far commoner, indeed, than it should be, and thus, from the frequency with which it is met with, it demands careful consideration. Secondly, it is in most instances a preventable malady, and, were the conditions to which it is to be attributed more generally known, it would soon become more rarely encountered. Thirdly, and lastly, although frequently fatal, it is generally an essentially curable disease, and one which should not be neglected. It should be studied, because it is to the interest of the stock-owner to study it carefully and thoroughly.

The condition termed tympanites or hoven, depends upon distension of the first stomach, or paunch, or rumen, by gases. The term tympanites (*tympanum*, a drum) was given to this disordered condition, from the very low-pitched note which is emitted, when the left flank of animals whose rumen is thus distended with gas is percussed. We may as well state, in the first instance, that such accumulation of gas in the paunch is the result of impaired digestion in this stomach, and that, although generally seen as an independent affection, it is, nevertheless, very common in other disorders of the system. This latter fact, indeed, is only what one would naturally expect would be the case, seeing that in many disorders rumination is suspended, and fermentation of the food thus results.

The causes which one finds most commonly productive of hoven are sudden changes in the diet, feeding upon green crops

containing too much water, or on grass or clover upon which rain or dew has been deposited (Armatage).

When sheep or oxen are placed upon very luxuriant spring grass, the complaint is very apt to break out. Sheep, when removed from a thin pasture to a richer one, as, for instance, of clovers, acrid plants, and so forth, or those which are being fed upon frosted roots or root-tops, or a superabundance of mangolds at an early date in the season, are especially liable to attacks of this malady. In order to lessen the suddenness of a change from a small allowance of food to an abundant supply, as, for instance, when hungry animals are taken to rich food, at first they should only be allowed a run of an hour or two at a time, until they are accustomed to their new aliment. Especially is danger to be feared from rich grass which is wet with dew or rain. Even good sound food may bring on an attack of hoven, in case animals which have fasted for a long time are supplied with a large amount of it. Moreover, it is important to remember that if an animal has once been attacked with this disorder, it will easily fall down again with it, provided that a slight cause should be in operation. Again, animals which are kept upon dry food frequently become very thirsty, drink eagerly of cold spring water, and so go down with hoven. It is necessary to exercise very great care in regard to the regulation of the food and the water supplied to hungry animals.

It has been noticed that this disease is common when the glands which secrete the saliva are diseased, and that when cattle, poorly kept on water or hard food, are first put upon grass or clover, they are especially liable to become hoven or blown. The disease is common also in cases where the third stomach, or manyfold, is obstructed, and when there is any affection of the second stomach or reticulum.

Hoven is easily recognised by the swelling on the left side. This makes its appearance while the animal is partaking of its food or soon afterwards. The symptoms are rapid, as a rule, in their appearance. The first stomach which, as we all know, is called the rumen or paunch, becomes greatly distended with gas, and consequently extreme pain is experienced. The whole body is enlarged, especially on the left side, which, when tapped, gives forth a hollow sound, and also rebounds when pressed upon. The rumen presses on the diaphragm, and consequently the

breathing becomes arduous, the blood circulates with difficulty through the blood-vessels going to and from the stomach, and its course is diverted from the stomach to the brain. A kind of stupor, as shown by an unwillingness to move and so on, rapidly supervenes, and the suffering animal abstains from both eating and drinking. The breathing becomes distressed as the gas accumulates in the rumen, causing it to press upon the lungs; and then it becomes still more distressed and laboured, and at length the animal pants and moans in great pain. The nostrils are dilated so that as much air as possible may be inhaled; saliva dribbles from the mouth, and though there are eructations of gas, there is no eructation of food, rumination being sus-

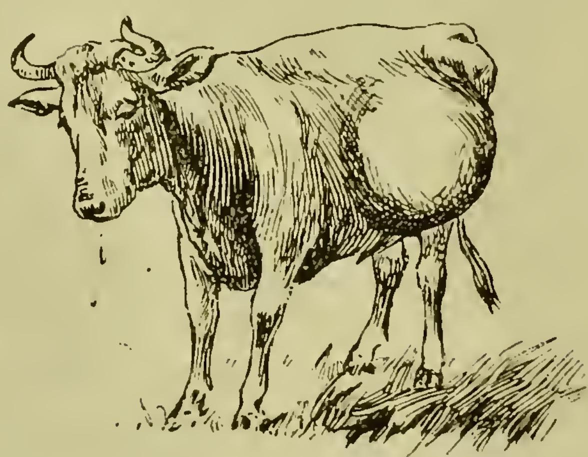


Fig. 60.

This illustration depicts a beast suffering from hoven. The rumen is so enormously distended that the ox looks as if its left side would almost burst open.

pended. As the accumulation of gas increases, the animal pants and moans, and standing in one position, with arched back and wild, bloodshot, staring eyes, it is a picture of misery, which is truly characteristic. The protrusion of the eyeballs, and wild staring look of the poor creature, are caused by the accumulation of gas to such an extent that the passage of air into the lungs is obstructed.

As suffocation is impending, the animal staggers to and fro helplessly, and, insensibility at length supervening, he falls prostrate to the ground. In this condition he may vomit, and thus relieve himself in some degree. In some instances, so continuous and violent are the retchings, that the rumen is ruptured and death ensues. Unless curative methods are employed in cases of acute tympanites, death results in this manner, or from suffocation, or

from absorption of the accumulated gases into the blood. The gases which are found in the rumen are those known as carburetted and sulphuretted hydrogen, and carbon dioxide and monoxide, and when passed through a cannula, they will burn.

In regard to the treatment of acute tympanites, active measures, we must point out, should at once be taken. If the animal is ready for the butcher, immediate disposal of it for food should at once be advised. The disorder may be treated by the help of the probang, the cannula for the rumen, or by means of the administration of certain drugs, preferably those of an antiseptic nature. Except in very urgent cases, of which we shall shortly speak, and for which the best treatment consists in puncturing the distended rumen with the trocar, diffusible stimulants administered promptly are efficacious in dispelling the accumulated gases. The remedies of the stimulant class which are highly valued are solution of ammonia and carbonate of ammonium in solution. Of the antiseptic remedies, the sulphite and hyposulphite of sodium are most valuable. A draught which answers as well as any is made of one fluid ounce of solution of ammonia and two fluid ounces of tincture of cardamoms, and this may be given in a quart of warm ale, and may be repeated in an hour and a half if necessary. If the aromatic spirit of ammonia be given, four ounces may be similarly administered in warm ale. After abatement of the acute symptoms, a full dose of Epsom salts with ginger and caraway seeds should be given in three gills of warm water, eight drachms of aloes in solution in eight ounces of water being added. For some days after recovery, the animal must be kept on a very restricted diet. The hyposulphite of sodium, in doses of half an ounce, given in a pint of warm water, is a very good draught in cases of tympanites, its value depending upon the power it has of arresting further fermentation and consequent formation of gases generated in the decomposition of the elements of food in the rumen. In very severe cases it is best for the veterinarian to pass the trocar and the cannula.

The spot chosen for this operation is half-way between the last rib and the haunch-bone or ilium, and about four inches below the lumbar processes. The most prominent part of the swelling is generally a sufficient guide for the operator in puncturing the rumen in such cases. For the ox, the trocar is

generally made about eight inches long. For the sheep, the instrument used is necessarily much smaller. Before the operation is performed on the ox, the animal must be secured by the horns, and the operator should stand on the left side in front of the hind leg. The operator quickly plunges the instrument into the paunch, then he withdraws the stilette, and leaves the cannula

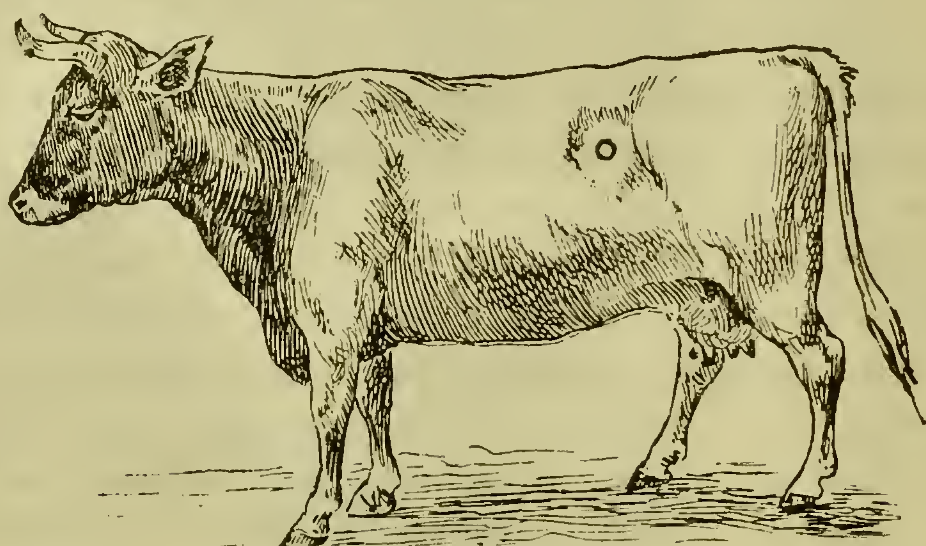


Fig. 61.

The above illustration depicts a cow, on which the exact spot in the flank whereat the rumen should be punctured in cases of tympanites is shown.

in position, to allow of the continuous escape of the gases. The cannula is tied in this position, and kept there until the gas has ceased to be produced.

If the sufferers are in-lamb ewes, or sheep out of condition, about half-a-pint of linseed oil may be administered. If, in the course of two hours or so, no relief is thereby obtained, it may

Fig 62.

The above illustration represents a trocar encased in its cannula.

be as well to give half-an-ounce of aromatic spirits of ammonia in a pint of warm water; or, if the ammonia is not at hand, about six fluid ounces of brandy or whisky slightly diluted with warm water may be administered. If the animal be very severely affected, the rumen may be punctured by means of the trocar, and when this is withdrawn, the cannula may be tied in the wound made, and left in for even a day or more—in fact, as

long as any signs of the ailment are exhibited. The instrument may be plunged into the left side with judgment, and the correct point for the operation is situated at an equal distance from the hip bone, the last rib, and the lateral processes of the spinal column.

The shepherd should be provided with a small trocar and two cannulæ. The cannula may be plunged into the hole made in the flank, and then retained in its position by means of a string passed round the animal, or held there by the hand until the gas has been set free. After the operation is over, the rumen soon heals up again. In former times sheep afflicted with this disorder were treated very barbarously and cruelly.

CHRONIC TYMPANITES OR HOVEN, OBSTRUCTION OF THE GULLET AND CHOKING.

We have just spoken of acute tympanites, its causes and symptoms, and of the fearful distress it occasions oxen. Before leaving this subject, we must speak of the chronic form of this malady so commonly met with. The causes of the chronic form of tympanites or hoven are pretty much the same as those of the acute variety. But, no matter what food be given, chronic hoven is apt to recur at frequent intervals, owing no doubt in great measure to the dilated condition of the walls of the paunch, which are unable to contract on the food ingested. The treatment of such cases as these is, as a rule, not attended with much difficulty.

After a moderate purgative has been given, vegetable tonics administered twice daily are most likely to be serviceable. Two ounces of powdered gentian, one ounce of ginger, and one ounce of fenugreek may be given in three gills of warm water or ale twice daily, and this treatment may be continued for several days, as may be indicated. When the appetite is bad, two drachms of powdered carbonate of ammonium may be added to each drench. Powdered nux vomica in doses of half a drachm is also a very useful addition in these cases, where the digestion is very sluggish.

Hyposulphite of sodium and sulpho-carbolate of sodium owe their value in cases of acute and chronic hoven to the powers they possess in inhibiting the fermentative process in the foods

taken. There are also other important points to be borne in mind in these chronic cases. The food should be somewhat restricted in amount. It should be light, and should be given at regular intervals. Exercise is beneficial in these cases. Much also will depend upon the general management of the animal.

Before passing on to the consideration of the other diseases of the paunch, we propose to treat of obstruction of the gullet and choking in beasts, and of the treatment necessary in such cases. The impaction in the gullet of portions of food, such as pieces of turnip, mangold wurzel, potato, carrot, or of such foreign bodies as pieces of wood or other hard material, is unfortunately a common occurrence. A knowledge, therefore, of this subject should be gained by all those who have to deal with the management of stock. Even the uninitiated have not very often any difficulty in recognising a case of choking.

When the passage of the gullet is obstructed by the lodgment of a foreign body, the offending matter may be situated in the first portion of the gullet. In these cases the choking is spoken of as pharyngeal. In other instances the body may be impacted lower down in the neck, when the choking is spoken of as cervical. Lastly, the body may be lodged in that portion of the gullet which is situated in the chest cavity, and in these cases the choking is spoken of as intra-thoracic (within the chest). We may first say a few words of the general signs of choking, and then we propose to speak of each variety separately.

Choking, it must be pointed out, is not always occasioned by the lodgment of portions of food as they descend towards the stomach, but may also be caused by the impaction of food during its regurgitation towards the mouth during rumination. A choking animal becomes uneasy, and has difficulty in breathing, and coughs frequently. The saliva, in viscid, ropy strings, dribbles from the mouth, the jaws move continually, and the head is held out in a peculiar, stiffened manner. The animal attempts to regurgitate the impacted matter, and moans at frequent intervals. The appetite is lost, rumination is suspended, and if the poor creature drinks anything, the fluid is returned through the nostrils. One of the worst symptoms, and indeed the only symptom of any real danger in cases of choking, is the accumulation of gases in the rumen, which organ becomes swollen up and distended in an inordinate degree. This symp-

tom is the one of all others which renders early and immediate treatment of such importance in these cases.

There is another fact regarding choking which we may mention before speaking of each variety in detail. The obstructions are especially prone to recur in animals which have once suffered, and this we must attribute to the straining of the walls of the gullet at the spot where the previous obstruction occurred.

In the first variety, the pharyngeal, the offending body is lodged at the point where the gullet opens into the pharynx, at

Fig. 63.

In order to depict more clearly in the above illustration the manner in which the operation of passing the probang is performed, some very necessary details which would be absolutely essential in actual practice have been omitted. For instance, it would be indispensably requisite that two powerful men should stand on each side, and take a firm hold of each horn, in order that the beast which was being dealt with should not be able to work any mischief with those appendages, and other very effective measures of precaution in this respect would also have to be carried out.

the back portion of the mouth. In these instances the head is poked forward and held low down, with the nose protruded and the neck stiffly stretched. Cough in these cases is violent, spasmodic, and frequent. The saliva flows copiously from the mouth, and the animal's paunch is distended with gas. The breathing is very difficult indeed. The eyes are protruded and blood-shot, the pupillary openings are dilated, and the animal altogether is a picture of misery and distress. The offending body can be felt at the back of the windpipe, and it protrudes generally towards the left side of the animal.

In the second variety of choking, where the body is impacted in the neck, it may be seen and felt. In these cases the symptoms are not so urgent as in those described. In some of these instances of cervical choking, moreover, the animal is able to drink a little, and thus the fact of the lodgment of a foreign body, sometimes not being suspected, is overlooked.

In the third, or intra-thoracic, variety, the body is obstructed in the gullet, as this passes from the neck into the rumen or paunch. The signs of this variety are more obscure, for of necessity one cannot see or feel the offending body. In some instances the obstruction may continue for several hours, or even a day or two, without producing urgent symptoms. Tympanites may then set in, and when this happens, the animal becomes suddenly much distressed, the breathing very difficult, and even death may ensue. In this kind of choking the animal may take fluid, and this distends the gullet, and is then, as it were, vomited through the mouth. There is no coughing in these cases, and there is little discharge from the mouth. Tympanites, indeed, may be the only symptom to be observed. When we have reason to suspect choking in an animal, the hand should be passed down the gullet, in order, if possible, to detect the foreign body, which, if found, should then be gently manipulated downwards, so as to pass it along the gullet.

It is best in these cases to give a small quantity of linseed oil to lubricate the foreign body, and thus facilitate its manipulation. If the body be near the upper portion of the gullet, it may be pressed upwards. If very near the mouth, it is not uncommonly quite possible to reach it with the hand, and thus relieve the animal without any more difficulty. If we are unable to manipulate the foreign body, the probang must be introduced without further delay. The probang is a hollow tube, sometimes made of a spiral coil of wire covered over with leather, tipped with a broad, cup-shaped metallic or wooden end. The length should be not less than six or seven feet. For sheep the probang is not more than three feet long.

In order to pass the probang, the animal must be secured, and a gag held or strapped in the animal's mouth. The probang is well oiled, and passed backwards steadily. When the operator feels the obstruction, by moderate and steady pressure he must endeavour to force it downwards into the rumen. As soon as

the offending matter is dislodged, the animal is relieved, the distressing symptoms vanish, gas escapes from the rumen, and the animal soon commences to feed. In passing the probang, great care should always be exercised, as accidents are not by any means rare. When the instrument will not dislodge the foreign body, pressure should be discontinued for a minute or so, and then should be again exerted firmly and steadily.

Should the attempt even then be unsuccessful, it is best to withdraw the probang, and, after a short interval, to attempt it again; and even a third and fourth time. Even when great care is taken, the gullet may be ruptured; and the services of a qualified veterinarian are therefore necessary in cases of choking. In an instance which came before our notice some time ago, the owner, who used an instrument of a very dangerous character, perforated the gullet, and the probang found its way into the tissues of the lungs. After much suffering, the poor cow died in great agony. Even whip-stocks have been employed in these cases, and cart ropes; but the use of these instruments is very strongly to be condemned. When the gullet is ruptured, an event generally recognised by the swelling of the neck, slaughter of the animal immediately is the only course to be adopted. In those instances where great difficulty is encountered in passing the probang, and gases are accumulating rapidly in the rumen, the trocar should be passed in order to obviate danger of a fatal issue, until relief can be obtained by means of the probang.

After the probang has been passed with success, the animal should be fed upon soft food for several days, and on no account must any roots be given until the gullet walls have had time to recover their normal tone. In those instances where the foreign body is impacted in the neck, and nothing will remove it, the operation of opening the gullet has been performed as a last resource. In this operation, termed "œsophagotomy" an incision is made through the skin, and the foreign substance is cut down upon, and removed. The edges of the lining membrane of the divided gullet are then securely sewn together with catgut or silk sutures, and the animal is fed upon gruel and mashes for some days after the incision. The operation itself is not difficult, but there is great difficulty in the healing of the wound owing to the continual passage of food down the gullet. In

cases even apparently successful the walls of the gullet may be contracted in the healing, and thus the animal will be likely to choke, when he commences feeding on solid food, and this may happen very often.

Sometimes stricture of the gullet is occasioned by frequent choking and partial laceration of the walls, and in these cases choking becomes very common. In such instances the animal must be fed on a carefully regulated diet, and should be fattened and killed as early as possible.

Œsophagotomy is indicated in those instances when the gullet walls are partially lacerated. In these cases a pouch or sac having been formed the foreign body passes into it, and choking is therefore very common.

PLENALVIA OR ENGORGEMENT AND INFLAMMATION OF THE RUMEN.

Engorgement or impaction of the rumen, as also that of the omasum, are especially of great importance. This name is given to a condition of distention of the rumen, or first stomach, in consequence of the presence of too much solid material in that organ. This arises from the taking in of too much food or from rapid eating, especially of succulent food.

If placed very freely before a beast, grain-food, chaff, potatoes, or in short anything particularly inviting may be eaten in excessive amount, and the consequence is that the muscular coat of the rumen, not being sufficiently powerful to contract on the contents of that organ, movement of the solid mass and digestion altogether cease.

More particularly is it the case that animals which have previously been feeding upon dry food and are suddenly put upon luxuriant pasturage are very liable to suffer from this derangement. Sheep which have been taken from poor to rich pasture frequently overfill the paunch, and this is especially the case when they are kept on turnips for a considerable time. The oppression of the animal is greater than it is in the case of tympanites, in which there is a distension of the paunch with gas, as we have already said, and the belly is not usually so greatly distended, nor do the flanks yield to pressure. As in the case of animals which are afflicted with hoven, symptoms of distress are very evident; but if the rumen be pressed upon

from the outside, it is a matter of little or no difficulty for the observer to distinguish betwixt the soft mass which is present in animals afflicted with plenalvia and the gaseous distension which exists in the case of animals suffering from hoven.

Symptoms.—As in cases of tympany, so also in cases of engorgement of the rumen, there is a swelling to be observed on the left side in the place under which the paunch is situated. The animal is dull and suffers pain, does not chew the cud, has no appetite, is constipated (the feces being hard and glazed), and has a small and quick pulse. The onset of these symptoms is more gradual than it is in cases of tympany, the disengagement of gases being a more rapid process than is the filling of the paunch with solid food owing to a voracious appetite. Moreover, the swelling in tympany is not unlike that of an inflated bladder; while, when engorged, the rumen has a soft, doughy feel, and it is not resonant on percussion; but, on the contrary, the swelling pits when it is pressed upon, and the impression made upon the yielding substance remains for some time after the hand has been removed.

Should the animal assume the recumbent posture, it lies down with its right side nearest the ground, evidently to avoid pressure on the distended and painful paunch. As a rule, at a later stage, hoven (or tympanites) supervenes, and then the animal breathes with difficulty, moaning in expiration, grinds the teeth, and remains standing with arched back and muzzle protruded. Inflammation of the lining membrane of the rumen not infrequently comes on, when the engorgement has remained for some length of time, or it may set in after the operation of rumenotomy has been performed. The animal breathes quickly, is very tender to pressure on the side, shows signs of thirst, and has a dry muzzle.

The symptoms in sheep are as follows:—The sheep is excited, delirious, and drowsy, and so insidious in its course is the disease, that even a few hours before death the animals may appear to be healthy. However, the usual signs are marked enough. The sheep shows general fever, difficult breathing, dilated nostrils, quick and full pulse, inflammation of the conjunctival and nasal membranes, dry muzzle, depressed and cold ears, heat at the base of the horn in the case of horned sheep, frequent and painful cough, a swaying of the body forwards and backwards,

loss of appetite, cessation of rumination, diminution or cessation of the secretion of milk, costiveness, and occasionally a trembling of the muscles. Then the animal stretches out the neck, protrudes the eye, gives out a discharge of frothy or slimy fluid from the mouth, and of blood-tinged mucus from the nose. The pulse is quicker and small, the ears are colder, the roots of the horns cold, the breathing laboured, and the general condition wasting. There may be at times temporary delirium, and this may be accompanied by attempts to do mischief.

Mr. John Hawes, of Taunton, recorded, in *The Veterinarian* for the year 1840, the following interesting facts. A flock, consisting of more than 200 sheep, strayed into a field wherein was a quantity of wheat which had not been taken away, owing to the unfavourable weather. On this wheat the sheep fed very fully, before being discovered by the shepherd, who, of course, on noticing them, immediately caused them to return to the pasture on which they had previously been grazing. However, the removal turned out to have been effected not sufficiently early, for on the very next day four of the sheep were found dead, several others also being very ill. This was not the worst, for on the morning of the next day twenty-eight sheep had already died, and nearly as many more were apparently tottering on the verge of death, while at the close of the fifth day after their escapade no less than fifty-eight sheep were lifeless carcases. The remaining members of the flock recovered; but many of the in-lamb ewes subsequently threw their lambs, doubtless in some measure as a consequence of what had occurred. In each carcase examined after death the rumen was found to be full of wheat, barley, and straw. Moreover, the abomasum and the bowels were highly inflamed, while the spleen was broken up to such an extent that it presented the appearance of a mass of coagulated blood. The liver, lungs, and other organs appeared to be healthy.

As a curative measure, Epsom salts and castor oil in suitable doses may immediately be administered to all those animals which evince symptoms of this disorder, and some may be bled, and half a pint of linseed oil given to them. It is a good plan to administer to animals suffering from plenalvia a large quantity of warm water by means of the stomach-pump, and purgatives should also be tried. A dose of aperient medicine, as said above

—for example, about three ounces of Epsom salts dissolved in a sufficient quantity of water or gruel—may be given. In cases of extreme urgency, either immediate slaughter on the one hand is to be recommended, or, on the other hand, the operation of rumenotomy is to be performed, since this measure is the only one which can be of any real service to the suffering animal. The incision is to be made into the paunch on the left flank, and then the contents of this receptacle for food can be mechanically removed. After the cutting has been suitably carried out, the edges of the incision into the rumen should be brought together, and also into apposition with the flank, and then a few stitches should be passed through both the rumen and the skin, so as to keep the opening into the rumen in contact with the aperture into the side of the animal's body.

If there be any sign of decomposition of the matter contained in the rumen, the whole of it should be removed, and thrown away; but if no putrefaction is suspected, only about two-thirds of the contents need be taken out. After this has been done, it will be well to sponge the part with warm water and then dry it, and then place upon it a piece of tow, covered with some mild and efficacious ointment, and keep it fixed in position by means of a bandage passed round the animal's body. In about three weeks' time the wound will be found to have healed; but for many a week the sheep will not thrive very well.

Engorgement of the rumen in oxen is a disorder which it is not easy to cure. It is wise to prescribe some such draught as the following:—

Epsom salts—16 ounces.
Solution of aloes—4 to 8 fluid ounces.
Powdered ginger—1½ ounces.
Aromatic spirit of ammonia—1½ fluid ounces.

The above ingredients are to be mixed with a rather large amount of warm gruel, and the draught is to be given slowly and carefully by the aid of a suitable horn. This may be followed up with about half a pint of linseed oil for the purpose of lubricating the passages, and if there be no relief after twelve hours, the first draught may be repeated; or, better still, two pints of castor oil given. Should there be any marked tympanites in addition to the engorgement, the puncturing of the rumen is advisable. External manipulation over the region of the rumen may be

useful, and hence the animal's left side should be well rubbed with the hand. A little exercise should be given. Some may recommend that warm water should be injected into the stomach by means of the stomach-pump.

In some cases the operation of *rumenotomy*, or *paunching*, as it is sometimes termed, must be performed. With this purpose in view, the animal is first placed with the right side in contiguity with a wall, just at the end thereof, and the tail must be firmly held round the corner towards the right side. The nose is held firmly with pincers, and firm pressure must be applied to the left shoulder and hip, so as to prevent the animal moving too much to the left. The skin and outer layer of muscle is then

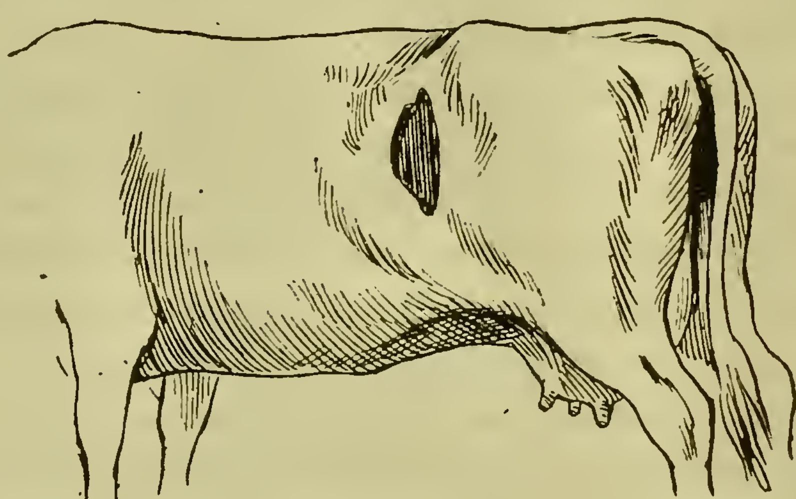


Fig. 64.

This illustration shows an opening into the rumen for the purpose of a mechanical removal of its contents.

to be cut through, beginning from about the same spot as that spoken of as the site for puncture of the rumen, viz. about a hand's breadth from the projection of the hip and a hand's breadth from the last rib. The incision is to be carried directly downwards for about six inches. Then the inner layer and the peritoneum are to be divided, the rumen being thereby exposed. An incision big enough to allow of the entrance of the hand must be made in the rumen, near the top of the incision. The exposed edges of that organ must then be held, and retained in firm grasp by suitable hooks, or better still, the rumen must be secured to the outer skin by means of metallic sutures. A thin linen cloth, or a large silk handkerchief, or a good-sized towel is to be carefully introduced into the paunch in a grooved manner so as to act the part of a bridge, over which a large

portion of the contents may be taken from the rumen by the hand. The operator is thus enabled to remove the accumulated material, but he should not empty the organ completely. It is in very many cases necessary to cast the animal, in order to perform rumenotomy.

Before closing up the wound, it is well to ascertain the state of the reticulum and omasum. This operation should not be delayed until an animal is well nigh exhausted, and therefore unable to withstand its weakening effects. The artificially-made aperture in the rumen must then be closed with carbolised catgut sutures, and the edges of the wound must be inverted. The muscular wound, and likewise the external one, should then be closed up with metallic sutures. It is wise, if practicable, to apply the carbolic acid, or corrosive sublimate, spray, when operating. The wound generally heals quickly; but it is best to fatten the animal for the butcher as soon as possible, since the rumen frequently grows to the side. Soon after the operation, a dose of cathartic medicine may be given, and for a few days following, stimulating aromatics may be administered. Until the rumen has quite regained its former tone, soft food alone should be allowed. That which originally caused the disorder should be avoided. The return to the ordinary diet should be very gradual, since the malady may easily be brought on again.

If, either after this operation or in the natural course of the engorgement, inflammation should supervene, medicine must be given with the view of checking the fever, and the very greatest care must be exercised. In these cases purgatives cannot be given, with the exception of a little oil. Enemas, however, may be resorted to, as also bleeding, if it should be found necessary. The abdomen should be well fomented externally.

RUPTURE OF THE RUMEN.

This accident sometimes occurs as a result of tympany, whether it be primary or attendant upon engorgement, or it may be the consequence of a wound or wounds, or due to an injury received by the rumen when engorged, or to the presence of irritant substances acting either chemically or mechanically. Escape of the food contained may occur, and bring on the very generally fatal disease called peritonitis, or indeed almost immediate death.

FOREIGN BODIES IN THE RUMEN, THE RETICULUM, AND THE ABOMASUM.

The presence of certain substances in the two first stomachs of ruminants is not very uncommon. These bodies bring on indigestion, produce a tendency to chew the cud irregularly, and also an increase of that particular depravity of appetite in accordance with which the peculiar substances were originally swallowed. Needles have been known to pass from the rumen or reticulum to the heart, where they necessarily produce great mischief and disturbance of the normal cardiac functions. In cases where articles of this nature have been taken in by a beast, there may be vomition, tympany more or less permanent, and general anæmia. Parasites, and calculi, especially those which consist essentially of concretions of hair, are sometimes present in the rumen. The *Amphistoma conicum* is a parasite which is similar in appearance to the papillæ in the deep saccules of the paunch. Tape-worms also have been found in the rumen, and the *Cysticercus tenuicollis* is sometimes attached to its outer surface.

"Hair-balls" result from a habit which cattle have of licking themselves or one another, whereby a great deal of hair may be swallowed. The hair is mingled with particles of food, bound together into a mass by means of the mucus which is present in the rumen, and impregnated more or less markedly with salts of lime. These become round, owing to the movements of the stomach, or they may be polygonal with rounded edges, if there be many present. The balls are light, though of rather large size. Their weight is from a few ounces to as much as seven pounds. As a rule, they are formed around a small piece of metal or a stone which has been swallowed. When of rather small size, they may be passed up into the mouth and rejected; but animals have been choked by larger balls being stopped, as they are passed up the gullet. Hair-balls may be found in very young animals. They may also be present in the abomasum, or fourth stomacn.

Again, what are known as bezoars, or calculi, may at times be present in the abomasum of sheep. Now, in past times it was believed that these bezoars were produced by magic, and not a

few persons were actually sent to the galleys because it was thought that they were at the root of this kind of mischief. Moreover, even in the last century, it was supposed that the stones were swallowed by the sheep, which animals, it was presumed, were very fond of them. Indeed, in France, in the year 1790, two labouring men were accused of having strewed calculi, which might have been obtained from a butcher, near some sheep. In consequence of the suspicions entertained against these two unfortunate labourers, they were actually condemned to pay a fine of 1,500 livres, and in addition to be sent to the galleys for a period of six years. This injustice, however, was not to be perpetrated, for the professors of the veterinary school at Alfort came forward and boldly stated that the sheep certainly would not of their own free will swallow these concretions, and, moreover, that even if they were forced upon the sheep, they could not possibly find their way into the abomasum, but, on the contrary, would naturally pass into the rumen, where they could not occasion the mischief complained of as having been brought about. Hence, fortunately, the unjust sentence was revoked, and the prisoners were set at liberty.

Not only, however, was it formerly the case that these bezoars were thought to be destructive to sheep, but they were also believed to possess wonderful virtues in regard to the cure of various ills to which human flesh is heir. For instance, they were thought to possess all the powers of disenchantment against the poison of the viper and that of the scorpion, against vertigo, epilepsy, dysentery, inflammation of the lungs, malignant fever, the plague, the leprosy, and many other maladies. It was put down to the astonishing power of the bezoar that King Edward IV. was strengthened and preserved from the effects of an empoisoned wound, and the same magical influence was supposed to be the real reason why the Emperor Charles V. was enabled to free himself from the dreadful thoughts which haunted and disturbed his mind.

These bezoars, it should be remembered, are by no means peculiar to the sheep. Occasionally they may be found in every species of deer and antelope, also in the elephant, the rhinoceros, the porcupine, and some other animals. In former times those which had been taken from some species of Indian antelopes were highly prized, and some from the elephant and porcupine

were actually sold for the seemingly extravagant sum of £800 each. So far as is known, these bezoars are not supposed to be harmful when present in the abomasum.

Now, the next question which arises is—How are they produced? The fact is that the lamb, before being weaned, may, while engaged in the act of sucking, in the course of time swallow a rather large quantity of wool. In like manner, the adult sheep also may, in licking itself, collect a great many fibres in its mouth and swallow them, and these at length gain access to the abomasum. A hard piece of food, or any hard substance such as even a grain of corn, may easily also be near, and the wool may become entwined around it as a nucleus more and more completely. In accordance with the movements of the food contained in the stomach, the mass revolves, and it gradually assumes the form of a ball, more or less compressed on two sides, and varying in size from that of a small nut to that of a large almond. There may be only one of these balls, or as many as sixteen of them may be present. It is in the months of September and October that they are most usually found, this being the time of moulting in the sheep, and also the time when, the skin being irritable, the sheep are most apt to lick and gnaw themselves, and consequently swallow the greatest quantity of wool. If these balls are exposed to a very great degree of heat, they will burn, and they are also capable of being dissolved in boiling water. They are never discharged by the intestines.

ENGORGEMENT OF THE OMASUM, OR THIRD STOMACH. OMASITIS.

This disorder occurs as the result of the devouring of indigestible material, such as old fog-grass (which has not been eaten off in the autumn, but has been allowed to remain in a pasture until spring), straw, or dry and harsh and badly-gotten hay, and any coarse herbage or heath. Very bad hay can only be rendered slightly available by being mixed with a large quantity of cut turnips, mangold-wurzel, or grains.

Impaction of the third stomach in sheep, if severe, leads to inflammation of that stomach or omasitis. This disorder is also known under the name of fardel-bound, and also as grass-staggers, and it breaks out periodically both in the Isle of Man and in Ireland, doubtless in consequence of errors in diet. As

a rule, the malady occurs in sheep when, having been previously fed on soft and succulent food, they are transferred to that which is harder and drier; or, on the contrary, though this is not so frequently the case, when there has been a converse change in the dietary—for example, if they have been removed from a dry and bare pasture to soft and succulent grass. Indeed, so great is the risk resulting from sudden changes in the food-supply, that it has been observed that sheep invariably do best on farms

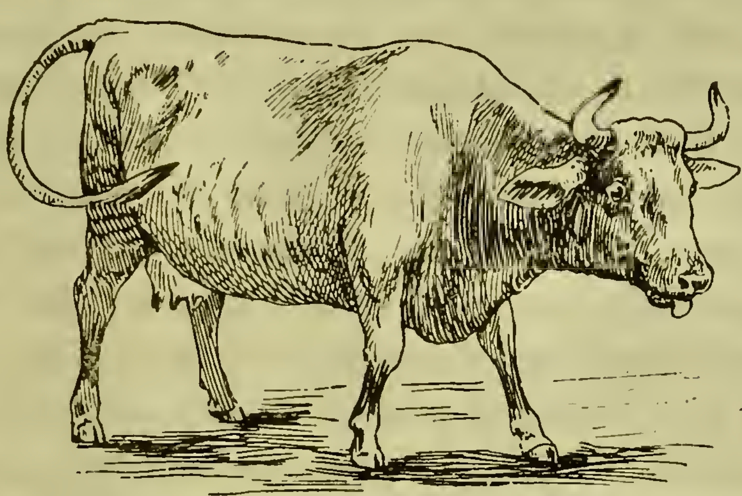


FIG. 65.—IMPACTION OF THE OMASUM.

The above illustration depicts the appearance presented by an ox suffering from impaction of the omasum. The head is seen to be held low, and the ears hang down pendulously; the breathing is difficult owing to pressure on the diaphragm, the tip of the tongue protrudes out of the mouth, the eyes are staring and bloodshot, the animal grunts and moans, and grinds the teeth. Pains are felt in the abdomen, and the nose is often carried to the flanks, most frequently to the right flank. The hind legs are often moved, the tail is lashed from side to side, the rumen is frequently tympanitic, the eyesight is impaired, and the eyes may be touched with the finger without pain being manifested or the lids being closed. The animal staggers, rolls on its side, and lies there with rigid limbs, is convulsed, and dies. If the beast be in the field, it runs about wildly, and may perhaps be found with its back downwards in a ditch in a helpless condition. If it be removed from the ditch, the animal may be found dead, or else suffering from irreparable damage to the spine in consequence of its violent convulsive struggles. (After *Armatage.*)

whereon the soil differs but little, for it is the rapid changes which are especially dangerous.

When troubled with this disorder, the patient frequently voids small quantities of hard, glazed feces, and afterwards is severely constipated. The animal stands persistently, it has a hard and frequent pulse, and suffers acute abdominal pain, which is manifested by an occasional grunt or groan. As in the case of stomach-staggers in the horse, the brain often becomes affected, muscular tremors over the surface of the body are to be seen, the eyes become insensible to light and assume a staring

condition. The poor animal, if moved, staggers, and may become quite paralysed, or, on the other hand, may rush about wildly, with protruded and greatly swollen tongue. Tympany also often comes on, and the urine frequently contains blood. There may be marked febrile symptoms.

After either a sheep or an ox has died in consequence of the disturbance known as omasitis, the omasum or manyplies, if examined, may be found to contain hard and dry material. However, we must not forget that, even in the general way, the contents of this stomach are in a certain measure dry, and, indeed, we ought to make ourselves quite conversant with the condition of this stomach in animals which have died when healthy, before we can presume to draw any conclusions regarding its state in any given case. If an examination be made after death has occurred, as a result of this disorder, the omasum may be seen to be as hard and as round as a ball, and, moreover, to be distended with hardened masses of dry and brittle food fixed between the folds or leaves which, indeed, have pressed upon the food so firmly, that they cannot be removed from it without the epithelium coming off and adhering to the food. Patches where congestion appears are found in the omasum, and sometimes congestion may also be observed in the rumen, and very often also in the brain and spinal cord.

Treatment.—With reference to curative measures, in the case of the *sheep*, the first point to be borne in mind is that purgatives, and especially aperient oils, are to be recommended. For example, about three or four ounces of Epsom salts or of Glauber's salts may in the first instance be given, while at every fourth hour about one additional ounce of the same may be administered. The medicine should always be dissolved in a sufficient quantity of warm water, or gruel, or linseed tea, and should be administered with extreme caution. No solid food should be allowed; but gruel should always be at hand, so that the animal can help itself, when inclined to do so. Moreover, warm water should be frequently given, either by the horn or by means of the stomach-pump.

Again, the maniplies may be distended with soft and putrid vegetable matter, if, for instance, the sheep has been removed from dry and bare pasturage to plentiful and succulent herbage. When this kind of material accumulates therein, the stomach

becomes distended and paralysed, while the contents rapidly decompose, and the result of all this is that dysentery of a fatal description supervenes. Our readers will see that this particular kind of mischief is not the same as that above spoken of. One ounce of Epsom salts may be suitably given in the case of an adult sheep suffering from this complaint twice on the first day of the disease, and doses of two drachms each may be administered every six hours, until the fetid smell of the discharge has ceased, and the feces have become more normal in character.

Now, in regard to the treatment of omasitis in *oxen*, it may be said that bleeding has been recommended, especially in the case of those animals in which the nervous system is greatly involved. Strong doses of cathartic medicine such as gamboge, solution of aloes, or even the drastic purgative, croton oil, in a dose of about forty drops, have been used. A new remedy for cases of very obstinate impaction has lately been used, and found highly successful.

The sulphate of physostigmine suitably dissolved has been injected intravenously in doses of from one-half to one grain, and hypodermically in doses of one-half to one and a half grain. This, however, would only be resorted to as a last resource, and by a skilful scientist. In ordinary cases, however, Epsom salts in a dose of sixteen ounces or more is useful, since, although it acts almost solely upon the bowels, it, by so doing, clears the way for aloes, which acts upon the stomachs. Oil is useful as an adjunct. If there be any inflammation, external stimulation should be resorted to in the region of the abdomen. Enemas should be regularly given, and the animal should be most carefully attended to. Nitrated water for drinking may be supplied in rather considerable amount.

INFLAMMATION OF THE ABOMASUM OR TRUE STOMACH.

In this disorder, which is of very rare occurrence indeed, there is acute fever, severe abdominal pain, and a curious stretching out of the fore-limbs, with the brisket almost to the ground (Youatt). After death, the interior of the organ is seen to be very red, and in it flaky mucus and sometimes blood are observable. The duodenum also is generally almost equally involved. Hair-balls are often seen in this mucus. Rupture of this organ

sometimes occurs, being due either to external injury or to extensive ulceration.

INDIGESTION.

In the first place, we may remark that nearly all the diseases connected with the digestive system, and especially those we are now about to discuss, viz. indigestion and colic, are as a rule the consequences of errors in diet. In regard to food-supply, one point at least may here be mentioned, and that is that oxen, so far as is possible, should always be supplied with food which requires re-mastication, that is, with hay, grass, or straw, in addition to any more highly nutritious foods used.

As we previously pointed out, ruminants are more liable to suffer from disorders of the stomach than from disturbance of the functions of the other portions of the alimentary canal, the reason being that the stomach is a very complex and important organ in these animals. Horses, on the contrary, are more frequently troubled with derangements of the actions of the intestines. It should, however, be borne in mind that a sudden or extreme change in the food supply, or any other great error in the dietary, will usually bring on derangements of the working of the stomach, or of the intestines, or of both, in almost any animal whatsoever. Again, the ruminating animals eat and swallow the coarsest food very rapidly, and they are provided with a large receptacle wherein the hastily-devoured food is reduced to smaller particles by a slow churning movement, preparatory to its being chewed over again. Hence the stomach in these animals more actively participates in the process of digestion than in the horse, and is, therefore, as we have said, the more liable to disturbances of various kinds.

In cases of indigestion in the ox, whether there be or be not any marked engorgement associated therewith, special treatment is requisite. Pepsin may be given to calves suffering from indigestion, when the disorder is due to imperfect secretion of the gastric glands, and it may be remembered that a little common salt given in the food in many cases promotes digestion.

Simple indigestion, or dropping the cud, may prevail among a whole flock of sheep and a great number of cattle, even extending to the animals on adjoining farms. It seems to be

due to the animals feeding upon unwholesome herbage or acrid or diseased vegetables, such as decayed turnips. The bowels act irregularly, the coat "stares," and, while chewing the cud, the animal repeatedly drops portions here and there. In the space of about two hours a large pailful of thick green fluid may be thus discarded. The animal loses flesh, the secretion of milk is damaged and then stopped, the appetite is impaired and capricious, and finally altogether lost. Unless strict remedial measures are taken, anæmia and dysentery come on. In the case of *sheep*, the wool may be shed, and if the flock as a whole is affected, the droppings may be found all over the field.

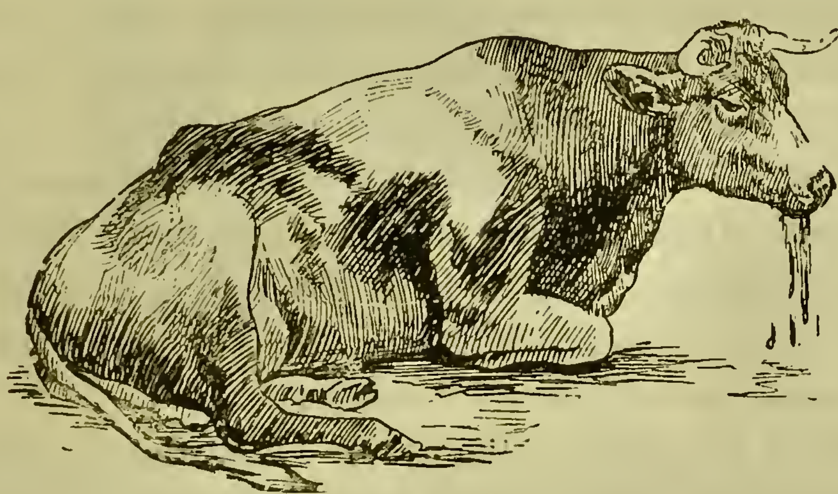


Fig. 66.—Dropping the Cud. Simple Indigestion or Dyspepsia.

In the above illustration our artist has depicted the typical appearance presented by an ox suffering from dyspepsia. The animal is "dropping the cud," and is seen to exhibit the look of a creature suffering from dyspepsia, lying on the ground, depressed and downcast, and altogether affording a marked contrast to the lively and sprightly look of oxen in vigorous health.

The leaves of mangold-wurzel, rushes, and the common wood-sorrel (*Oxalis acetoza*) are said to bring on this disorder.

Each ox should receive a draught containing Epsom salts (14 oz.), gentian ($1\frac{1}{2}$ oz.), bicarbonate of potassium (1 oz.), the ingredients being mixed together, and given in a pint of warm linseed gruel. For about six days, six drachms of bicarbonate of potassium should be mixed morning and evening with the food of each animal, or, if preferred, the powdered salt may be mixed with $1\frac{1}{2}$ oz. of gentian, and given as a draught in gruel or linseed tea. The cattle should, if possible, be taken to a high, dry, and large pasture. At any rate, the food should be entirely changed. Sound roots, good hay, with oil-cake, corn, or bran, may be allowed. It is often well to supply little or no

green food for a time, in the case of animals which have been taken up from grass in order to cure them.

There is a very severe kind of indigestion which is known under the name of "gastro-enteritis" of calves. In the adult ox, as our readers know, the rumen is very large; but it must be remembered that it is only after the young animal has been weaned that this first stomach gains its large increase of size. In calves the abomasum is the largest of the four compartments, and it is the receptacle in which the milk accumulates and then coagulates, and then undergoes the process of being digested. Manifestly the milk should be taken in suitable and not too great quantity; and, moreover, it should be of good quality. Sometimes, however, calves, especially those which are fed from the pail, take in too much milk—more than can be digested. The result is that the stomach becomes laden with a hard mass of solid curd, whereby death may ensue in consequence of the engorgement. Inflammation sets in, extends to the intestines, causing an acrid discharge in them, the consequence of which is expressed by the name "white scour." They may, however, on the other hand, be obstinately constipated.

It is well to administer alkalies in rather large doses, since, by their action, the mass of curd may be broken up, and the acid and acrid secretion referred to may be checked. If profuse diarrhœa comes on, stimulant tonics and cordials are useful in addition to more active medicines. It is advisable to diminish the milk allowed per day by one half, substituting linseed gruel in its place. This, then, is one form of indigestion in calves, and one which may be very serious. It leads us to the consideration of another form.

In calves which have been partially weaned, the abomasum may be the seat of accumulation of food-material in excess, when the first and third stomachs have not gained the power of suitably preparing the food for the true stomach. This engorgement may bring on obstinate constipation, and it is wise to administer oil in these cases, no matter whether the bowels be loose or confined.

Chronic Indigestion.—Though the distinction between acute and chronic indigestion cannot fail to be in large measure an arbitrary one, still, as in so many other similar cases, it is a kind of classification which furnishes a serviceable and convenient

division. A more or less disordered process of digestion is apt to occur in all kinds of animals for long periods of time. The disturbance of this function may arise in consequence of irregular feeding, inferior or bad food, want of exercise and confinement, insufficient or improper ventilation, and other sanitary shortcomings and faults, or from exposure. It may be due to the presence of foreign bodies or parasites, or to any cause which may obstruct the functions of the skin or damage the system generally, and thereby weaken all the vital processes.

Again, it may be due to a disordered or disturbed condition of

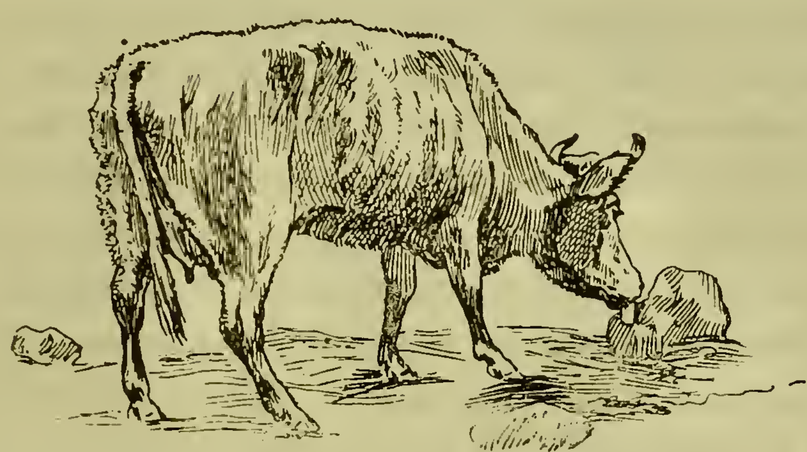


FIG. 67.—CHRONIC INDIGESTION.

An ox which suffers from a chronic form of indigestion, may, like the cow in the above picture, present signs of a depraved appetite. At the outset of the disease, indeed, the symptoms may merely consist of an irregular and slightly diminished appetite, which, however, may soon afterwards assume an extraordinary character. The animal may lick the walls, stones, wood-work, and even show a tendency to take into the mouth dirty straw, sand, stones, dung, and all kinds of filth. The coat is staring, the skin is dry, the flanks are hollow, unless they be inflated by reason of the presence of gases in the rumen, there may be much loss of flesh, and altogether the ox may present a most miserable appearance, which is very adequately represented in the above illustration.

the nervous system, such as is connected with the state of pregnancy; or, once more, it may be due to cancerous or other disease of the stomach, or to stricture of the pyloric orifice (that which connects the stomach with the intestines); or it may be brought on by the habit of drinking large draughts of cold water, or from the fact that the herbage is too scarce or indigestible and innutritious; or from cold and inclement weather, coupled with an insufficiency of shelter.

Chronic indigestion may show itself in various ways. At first there is usually an irregularity and slight diminution of the appetite. This afterwards not uncommonly takes on what is

called a depraved character, the animal licking walls, stones, wood-work, and even taking up dirty straw, stones, dung, and all kinds of filth into the mouth. The result of this depressed state is that the coat "stares," the hair standing erect, and the skin feeling harsh and dry; the fæces are small, hard, dry, and glazed with mucus; the flanks may be hollow, or swollen up from time to time, as a consequence of more or less strongly marked tympany; the temperature is generally lower than the normal standard; chewing of the cud is both irregular and imperfect; there is flatulence and torpidity of the bowels; loss of flesh may be marked and rapid, and the patient looks wretched and downcast, and presents what has been described as a tucked-up appearance. Other maladies may attack the debilitated animal. For instance, rheumatism may set in, or the bones may become weak and friable, or tuberculosis may make its appearance, or diarrhœa may come on, or tympanites, or impaction of the rumen, or colic, or other complications may ensue.

The malady should receive immediate attention. The causes should be removed. For instance, if the disease be due to the presence of a foreign body in the rumen or reticulum, and even according to some authorities in most cases of chronic indigestion in the ox, it is advisable that the veterinary surgeon should perform the operation of rumenotomy described in our last article. This is often to be recommended in the case of chronic indigestion of older oxen, since it seems that the mere removal of the long-retained food is often sufficient to restore the healthy condition.

Again, in young calves indigestion associated with convulsions is sometimes occasioned by the presence of "hair-balls." After a time, these may become gradually broken up by the movements of the stomach, and the symptoms will then slowly disappear. If the calf be in great distress from this cause, the pressing symptoms may often be relieved by stimulants, such as the carbonate of ammonium; but if the indigestion remains for a long period, rumenotomy should be performed.

There should be a complete change of diet, and of general surrounding conditions. Animals, if on low, marshy, lands, should be taken to sheltered straw-yards. If bad or deficiently nutritious food is being used, this should be replaced by small and repeated and gradually increased supplies of good and highly

nutritious aliment. At first the food should be laxative in nature, being made so, for instance, by having bran or cree'd linseed mixed with it, or by allowing moderate quantities of roots, green food, and so on. Strict cleanliness in regard to the surrounding conditions, and in other points, must be enjoined. The water-supply must be pure. The skin may be sponged with tepid water and then well rubbed.

It is well to cause the patients to take a certain small amount of regular and gentle exercise. In the first instance it is well in most cases to administer a brisk dose of cathartic medicine, such as 14 to 16 ounces of sulphate of magnesium. Then stimulants and tonics may be given. A draught made of bicarbonate of sodium (2 ounces), of sulphur ($\frac{1}{2}$ ounce), of ginger ($\frac{1}{2}$ ounce), of gentian (1 ounce), mixed with a pint of warm water, and given twice daily, may sometimes be benefical. It is best to call in the aid of skilled advice, because indigestion may proceed from such a multiplicity of causes that the specialist alone can properly diagnose and suitably advise in accordance with the conditions of the case.

SIMPLE COLIC, FLATULENT COLIC, CONSTIPATION, DIARRHŒA, AND SCOURING IN CALVES.

Simple Colic.

The disorder known as colic, under which appellative any abdominal pain not coupled with inflammation may be referred to, is very well known by all those who have to do with horses. In the case of cattle and sheep, the affection is fortunately of infrequent occurrence. For instance, a veterinary surgeon may be in practice for many years, and only be called to several well-marked cases of colic in the ox. In writing, we are reminded of two, one of which recovered, the other being of a very serious type indeed. As a matter of fact, if any beast seems to be going the wrong way, it is a very general, and perhaps in many cases wise, custom to nip matters in the bud, and so avoid the possibility of the loss occasioned by a fatal issue.

As our readers are aware, pains in the bowels are not unusually symptoms of various diseases which are by no means limited to the digestive canal. This observation, in fact, applies to all the diseases about to be considered in this article; in short, in many

cases they are the symptoms of a general disturbance of the system. When, therefore, we have to deal with cases of "colic," we should first investigate carefully the state of the animal with the view of removing the essential and primary causes of the malady from which our patient is suffering. For instance, the pains may be the consequence of herniæ of various kinds, or of impactions of the bowels, or of certain disorders of the liver, stomach, or urinary apparatus; but if such derangements are not present, it may be inferred that the symptoms point to a spasm or spasms of the bowels, to which the designation of "simple colic" has been given.

Notwithstanding its infrequency, this disorder may occasionally be brought on in oxen and sheep by any serious errors in regard to dieting. Moreover, in cases of severe indigestion, whereby the food eaten has only been very imperfectly prepared, and in this crude state is passed along from the stomach to the intestinal canal, the affection is often brought on by reason of the irritant action of these substances upon the walls of the alimentary tract. Among horses, the drinking of icy cold water after any great exertion, or soon after coming in from a hard day's work, is a not uncommon source of colic, and it is said that in the case of oxen also the same factor may be considered a fruitful cause of this painful complaint. Other irritant substances as well as undigested material are capable of giving rise to colic, and, finally, it is probable that the distressing symptoms referred to may result from simple engorgement of the intestines or stomach.

In this disorder there are paroxysms or fits of pain, which, so long as it lasts, is of a very severe kind indeed; so much so (especially among horses) that one feels the necessity of attending to the suffering animals with the most extreme care, if by any possibility any alleviation of the distress and agony can be gained. If this applies to horses and oxen, how much more does it apply to the human race. To see a man or a horse, or other creature, writhing and tossing to and fro in the excruciating agonies of colic, is to see a sight which cannot be forgotten. This torture —for torture, indeed, it may be called—is, so far as we know, produced by spasmodic and severe contractions of the muscular coat of the intestines in certain portions of its length. The fact seems to be, at least in some cases, that the irritant material

must be expelled at all hazards, and the sensitive canal is hence excited into violent expulsive action, which is probably the more forcible, the more need there is for gigantic efforts. The animal now and again moans and grinds its teeth in its agony, strikes the belly with the hind feet, turns the face towards the seat of pain, rises up suddenly, and again lies down, or throws itself to the ground.

As might be expected, the more restless the animal be, the greater will be its movements. A horse, suffering from a slight attack, will paw the ground, frequently turn the head to the seat of pain, and, if the pains become excessive, will kick and shiver, and throw itself with vehemence upon the ground, now with all four feet kicking in the air, now lying recumbent on one side, and now on the other. Frequently, if not taken well in hand, horses will seriously damage themselves; and if the violence of the suffering be not assuaged before long, the animal will almost certainly die. This also applies in a less degree to oxen, and in fact to all kinds of animals, and it has been well explained by Dr. D. A. Gresswell in his pamphlet on *Some Pathological Bearings of Darwinism*, on the theory that pain, being associated as it is with the struggle for existence as manifested in fighting, even when dependent upon disease, is to some extent similarly associated in the animal's mind.

In the case of colic, the animal is embarrassed in that it does not know the source of pain; but, nevertheless, the mechanism of its actions is so complex that, when it is suffering this severe agony, the energy which would have been useful to repulse the attack of an enemy is almost involuntarily expended, and in the same or a very similar way. Not only is this the case, but also we find the whole complicated machinery of work, as opposed to that of rest, is almost entirely brought into play. There is loss of appetite and cessation of chewing the cud; the animal sweats, frequently passes water in very small quantities, and, albeit that there is generally constipation, occasionally discharges a little fecal material. Tympanites, also, is very often brought on. Moreover, when the animal is actually in pain, the pulse is full, bounding, and quickened, while, in the intervals of freedom from suffering, it is very fairly normal. To speak briefly, there is in cases of colic a severe exaltation of the mechanism of work.

In regard to treatment, if the patient be a full-grown ox, the best plan is to give an efficient dose of cathartic medicine (such as sixteen ounces of Epsom salts), and enemas may be also tried. If the patient be a very plethoric animal, blood may be abstracted by the veterinary surgeon. In addition, a useful draught may be made of aromatic spirit of ammonia (two fluid ounces), and of tincture of opium (two fluid ounces). If no relief is obtained, this drench may be repeated within about an hour and a half. Again, we may give at intervals of four hours a draught composed of oil of turpentine (half a fluid ounce), of tincture of opium (one and a half fluid ounces), of spirit of nitrous ether (two fluid ounces).

The small intestines are sometimes affected in *sheep*. For instance, at times there may be some reason to suspect colic in lambs, especially in those which are immaturely forced on for the winter house-lamb market by being crammed with the milk of two ewes, and occasionally with cow's milk, as well as that of their mothers. When afflicted with colic, the animal exhibits signs of uneasiness, moans, rises up and lies down again, and strikes the belly with the hind foot. The grass lamb, taken from its dam, may at first be apt to feed upon acrid and half-poisonous herbage as well as on that which is wholesome, and it also is subject to colic. It may be advisable to administer a drench, made up of an ounce of Epsom salts, together with two drachms of ginger and twenty minims of the essence of peppermint. If the pain is not relieved, a second drench, composed of two ounces of Epsom salts may be given, and warm gruel may also be administered.

Flatulent Colic.

Flatulent colic among oxen is likewise of infrequent occurrence. The symptoms, though not so severe, are, on the other hand, more continuous, being due to the disengagement of gases, as is seen by gaseous eructations, and so on. Sometimes there may be a distension of the right side of the belly. As in so many other cases, it is best to give in the first instance a full dose of physic, and then to cause the animal to walk a little up and down, and in the intervals of repose to rub the animal's right side. Enemas should be administered, and manual exploration of the rectum is advisable. A draught of

solution of ammonia (one fluid ounce), of spirit of chloroform (one fluid ounce), mixed with a sufficiency of water may be given at intervals of four hours.

Constipation.

Constipation is a term given to a more or less complete cessation of the discharge of feces, or to the passage of small hard fecal masses coated with much mucus, or even with blood. There is generally a redness of the lining membrane of the bowels, and also of the eyes and nose. In like manner with colic, constipation also is very generally merely a symptom of disease. As a rule, the disorder is due to the presence of some impediment, as may be occasioned by strictures or engorgements of the stomach or intestines, or by tumours situated either within the bowels or in such a manner as to press upon them from the outside, by volvulus, intussusception, intestinal calculi, or concretions of various kinds.

With the view of counteracting constipation, which may, if unrelieved, lead on to gangrene and death, or to a fatal issue from other causes, the patient should be fed only on soft food, and a laxative should now and again be given. In many cases the malady is of such a mild nature that if enemas are administered, and the food be limited to bran, linseed, herbage, and roots, it will be gradually put right. In many cases it is wise to give a full dose of cathartic medicine when an ox is taken ill, and for this purpose, as we have pointed out previously, the sulphate of magnesium (generally known as Epsom salts) is most useful and least injurious.

If the medicine seems at first to be acting too violently, it will very frequently cease spontaneously after a time. On the other hand, it is truly astonishing how much cathartic medicine a beast will in some cases take. This may sometimes be due to fatty deposits around the rectum, or possibly to a hindrance to the passage from the rumen into the intestines. In several cases of obstruction of the bowels the veterinary surgeon will probably use the sulphate of eserine treatment previously referred to.

Now, we may also state that both before and after the time of being weaned, a lamb may suffer from constipation of the bowels as a result, for instance, of a bare and dry pasture, or from other causes. As we said before, in our account of diarrhœa, lambs

may be constipated when the milk of the mother is of peculiar quality, or when it is taken in too great quantity, and coagulates in the fourth stomach. A lamb, previously in good condition, may all at once, perhaps, become dull and unwilling to move; it pants, and is costive. If relief be not obtained, the lamb may die, and after death as much as 3 lb. or 4 lb. of curd may, perhaps, be taken from the abomasum. By way of treatment, plenty of warm water with three or four ounces of Epsom salts dissolved in it may be administered, either by means of a long-necked bottle, or with a Read's patent pump. After the bowels have been properly relieved, both the lamb and the mother may be taken to a pasture different from that on which they have been feeding. Again, constipation may be met with occasionally in full-grown sheep, as a result of the dryness of the pasture or of unsuitable or acrid herbage, or of a too plentiful supply of hay and corn.

Diarrhœa.

We now come in due course to the consideration of the very opposite condition to that last described. Diarrhœa is a somewhat difficult disorder to treat of, inasmuch as it may be due to so many different causes. As we have said above, and as our readers probably know well, colic and constipation are in not a few cases best considered in relation to the general disorders of which they, and especially the former, are merely symptoms. This is still more true, perhaps, of the affection which we are now to discuss.

Every owner of stock knows full well that diarrhœa is a very serious disorder. As well in the case of calves as in that of lambs, this derangement, which may, of course, arise from many different causes, is a source of considerable loss, both in the way of actually fatal issues, and also by reason of the emaciation and wasting which it occasions. Now, as our readers probably know quite well, diarrhœa is very frequently met with in animals rather as a symptom of disease than as a specific disease in itself, although it may be the chief, or perhaps even the sole noticeable derangement. It is necessary in all cases to determine the cause of it. Sometimes diarrhœa is due to inflammation, for the most part confined to the internal lining membrane of the small intestines, and as a rule not accompanied by much straining,

nor by any marked febrile signs. Of course, if symptoms of fever are manifested, it will be necessary to search closely into the case, and from minute observation we shall probably find that we have a more complicated disorder to deal with than simple diarrhœa. For instance, the name of dysentery is given, when the large intestines are inflamed and febrile symptoms are manifested, and when there is also a discharge of mucus. Diarrhœa may, however, be due to some irritation caused by maldigestion, or to some noxious substance taken into the stomach.

The more or less violent expulsion of rather fluid fecal material, sometimes of a very fetid odour, is met with as a symptom manifested with greater or less constancy in the case of very many different diseases. Of these we may just recall to mind:—Purpura hæmorrhagica, malignant catarrh, epizoötic pleuro-pneumonia, cattle-plague, anthrax, and many others. No doubt this diarrhœa is conservative, inasmuch as some of the virus is in this way eliminated from the system.

In the case of tuberculosis, diarrhœa comes on when the mucous membrane of the intestines or the mesenteric glands are affected, and the disorder may be due to other abnormal conditions of the intestinal walls, the lining membrane of which, after death from severe diarrhœa, may frequently be seen to be congested. An animal suffering from this disorder may be also afflicted with severe pain. As for the appetite, it is either diminished or depraved, while the chewing of the cud is irregular and imperfect, and the urine scanty in amount. Moreover, the animal may stand apart from the rest of the herd with an anxious expression depicted on its face, the feet drawn close together, and the back being arched.

The symptoms of diarrhœa are well known. Together with the copious discharge of more or less fluid excrementitious material, there is a disengagement of flatus, much straining, and the ears, horns, and feet, are cold. If the disease is due to the increased activity of the liver, whereby a large quantity of bile is discharged into the small intestine, the feces are dark brown in colour, watery, and profuse; if to milk of bad quality or an ingestion of too large a quantity, as sometimes happens in the case of calves, the discharges are light-coloured; if to blood diseases, they are often black and fetid, if to disorder of the

pancreas, they are generally light coloured. After death, the tissues generally present an anæmic appearance, but the lining membrane of the stomach and intestines is congested, and may possibly show more important changes. On the other hand, there may be merely the signs of an increased blood supply to the intestinal mucous membrane, which may not amount to congestion, and seldom can be called inflammatory.

In the case of calves and lambs which have suffered from diarrhœa while they are suckling, masses of coagulated milk are found, which, being undigested, are a source of irritation, so that, secretion from the intestines being aroused, and also muscular action, they are expelled with some degree of energy. In these cases the functions of the abomasum, the true digestive stomach, are generally suspended, the secretions being out of gear, and the tissues pale and wasted. A fatal issue may supervene owing to arrest of assimilation and the weakness which results from the excessive nature of the discharges.

In regard to the causation of this disorder, there is a great deal to be said. As might be expected, any irritation of the alimentary canal may bring on diarrhœa. Coarse food, acrid plants, the rank herbage of marshy lands, sloppy grass, excess of bran or linseed, the administration of purgatives, the change from dry to green food, or other sudden changes in the dietary, or in some cases, perhaps, mere excess of food, exposure to very cold and inclement weather, whereby the excretory function of the skin is arrested, so that the fluid, which under ordinary circumstances would escape through that channel, finds its way into the intestines, extra work being also thrown upon these and other internal organs—all these and other factors are to be borne in mind.

If there has been long-continued error in the dieting, or indigestion for a considerable period, chronic diarrhœa is often the result. The disorder may arise from an excessive or a greatly diminished flow of bile, and, according to some, it may be due to disturbance of the functions of the spleen or pancreas. Again, the irritation set up by the presence of parasites in one or other portion of the digestive canal may give rise to diarrhœa. This is especially true of the strongyles found in the intestines of calves and lambs.

The complaint we are now considering, viz. diarrhœa, may

be occasioned in sheep as a result of cold, in consequence of something being wrong with the milk of the mother, or owing to the first eating of the grass by the lamb when it is being weaned. Indeed, it is most natural that the bowels should be liable to disturbance at the time when such a radical change in the food is being undergone as that which then takes place, the grass then suddenly being perhaps the only food of the lamb. Moreover, it has been found, if lambs are exposed to great cold, or if the milk of the ewes is not good, or, indeed, very frequently if lambs, after being weaned, are incautiously placed on luxuriant keeping, that diarrhœa of a violent nature may be manifested, and lead on to death in less than twenty-four hours' time. As we have said above, diarrhœa is very frequently connected with some deterioration in the quality of the milk of the ewes. Also, it may be mentioned that, even when the lambs first begin to crop the grass by their mother's side, they are liable to suffer from occasional disturbance of their bowels, and naturally, as we pointed out above, this danger becomes especially great at weaning time.

Again, it may happen that, no sooner is the milk of the mother received into the true stomach of the lamb, than it is suddenly transformed into a firm curd, on the one hand, and into the fluid called whey, on the other, in consequence of the action of the gastric juice upon it. Further, if either the milk of the mother or the stomach of the lamb be unhealthy, this conversion may occur far more suddenly and decisively—indeed, to such an extent that the curd may be retained and accumulate in a marked degree, while the whey, on the contrary, rapidly passes through the bowels, thereby imparting the appearance of a kind of diarrhœa, which is often spoken of as "white scouring."

In these cases it may sometimes be found that the fourth stomach is quite full of curd, all its normal functions being entirely suspended. Although, then, the animal seems to be suffering from diarrhœa, the exact reverse of this is in reality the true state of the case, the sheep being, on the contrary, very much constipated. Moreover, this particular derangement is apt to come on when the lamb first commences to graze, at which time the functions of the stomach are naturally somewhat deranged. Under these circumstances the lamb is evidently distressed, heaves at the flanks, is unwilling to move, is greatly

swollen in the belly, and is either greatly constipated or, as we have above said, discharges whey. Occasionally, after death has taken place in such cases as these, the stomach has been found to contain as much as three or four pounds of this coagulum. It has been recommended that ammonia diluted with a large quantity of water, together with Epsom salts and ginger, should be administered to animals suffering in this way.

Perhaps the most usual cause of diarrhœa is the ingestion of young and succulent grasses, or perhaps a sudden change from a hot atmosphere to a cold one. As soon as the disease begins, the animals should, so far as it may be practicable to do so, be instantly removed from the pastures whereon they are grazing to older or drier keeping or food. Usually the eyes will be found to look heavy and the wool unnatural, while the step is sluggish and devoid of the elasticity of health. If so, a drench made up of half an ounce of Epsom salts, together with half a drachm of ginger, should be given, or, as a substitute for this, one fluid ounce of castor oil mixed with half a pint of gruel may be administered; and if great straining or much pain, or both, be exhibited, twenty drops of tincture of opium may also be given mixed with gruel. The lambs should be very carefully sheltered in a suitable place, well housed and nursed, and kept warm, and fed on dry food. If the diarrhœa still continues, and the bowels have been cleared as a consequence of the aperient drench, it will then be best to administer astringent medicines. If the disorder continues after twenty-four hours have elapsed, and if it is accompanied by the manifestation of pain and the discharge of much mucus, and by a loss of appetite, there will be some room for apprehension as to the result.

Mr. Youatt recommends that a mixture be made containing one ounce of prepared chalk, half an ounce of powdered catechu, two drachms of powdered ginger, half a drachm of powdered opium, and half a pint of peppermint water. The dose of this is from one to two tablespoonfuls at morning and at night. If the diarrhœa should prove to be of an obstinate character, the lamb ought to be removed from the mother, and it may possibly be found expedient to feed the little animal with cow's milk which has been boiled. The above preparation may be given until it, together with proper care and good nursing, has effected a complete cure. In the case of lambs, the complaint of which we are

speaking is generally due to improper or deficient food, or to lack of good shelter.

The malady is, of course, not confined to lambs, but also breaks out at times in full-grown sheep, when it is somewhat frequently attended with a fatal result, most particularly if it should perchance lead on to dysentery. It is very usually met with in the early spring time, when the new grass is quickly coming on. As in the case of lambs, so also in that of sheep, if diarrhœa continues for longer than a day, these latter should be at once removed to a pasture where the herbage is drier and less profuse, protected both from cold and wet, and supplied with hay. By way of medicine, a few doses of the mixture above spoken of for lambs may be given, or a preparation may be prescribed containing alkalies, together with aromatics and astringents. Alkalies in correct quantity may be very useful indeed, inasmuch as they will serve to neutralise the acidity of the contents of the intestinal canal, and so remove at once the prime cause of the irritation and of the diarrhœa. On the other hand—strange as it may at first sight seem—well diluted sulphuric acid in suitable doses may in certain cases be of great value.

As a preventive measure, if it should be found, or even only suspected, that there is something wrong with the land, the best plan seems to be to have it thoroughly ploughed over and drained, and then used permanently as arable land, if it is thought advisable so to do, or else well dressed with lime and again laid down to grass.

About ten to fifteen grains of salicylic acid suitably dissolved may sometimes be useful in the treatment of diarrhœa, and perhaps in that of dysentery in sheep. We may also give three more formulæ which have been recommended :—

1. Four tablespoonfuls of common salt, one teaspoonful of turpentine ; mix with a sufficiency of water and administer to the sheep, and repeat half the above amounts if necessary.

2. One teaspoonful of laudanum, one tablespoonful of rum or gin ; mix well and administer, and repeat the dose if necessary, but with half the amount of laudanum.

3. One drachm and a half of alum dissolved in half a pint of warm water.

In regard to treatment, the first point to be considered, and if

possible decided, is the cause to which the disorder is due, and especially if the diarrhœa is the result of local irritation, or if it be due to some general blood disease. If the latter, then the disease itself should be attacked. It may at first sight seem strange that now and again the best treatment for simple, uncomplicated diarrhœa may be found in the administration of mild laxatives, and especially those of a bland and oleaginous and gentle nature. Sometimes we may find it advisable to try a few soothing enemas. Manifestly, the purpose of these measures is the removal of any irritating materials which may be present. Great care, however, must be exercised in using any aperients whatsoever. The patient must be very carefully attended to. Mineral tonics and mild astringents are very useful, and tincture of opium is very greatly to be recommended, if there be much pain.

If the liver is sluggish in its action, it is well to give one drachm of calomel mixed with one drachm of powdered opium to adult oxen. The calomel increases the action of the liver, and the opium arrests the diarrhœa itself, and also keeps in check any undue purgative action of the calomel. The following formula may be useful, in case there is no torpidity of the liver to be observed:—Powdered opium (two drachms), catechu (two drachms), galls (two drachms), prepared chalk (one ounce). The mixture may be given in a pint of warm water twice daily. If there are scrofulous tumours, compounds of iodine and copper salts may be tried. Of the compounds of copper the ammonio-sulphate and the iodide are perhaps the best for this purpose.

The food-supply should be most carefully examined with the view of detecting faults of any kind whatsoever. The water may be bad, the cake used may contain mustard, the herbage may be rank, or it may be laxative from other causes (as is said to be the case in the scouring lands of Somersetshire and elsewhere). The aliment should be supplied in smaller quantity, if it has been full. Moreover, the food should be changed, very little water being allowed, and the diet should certainly not be laxative in nature. Gruel made with starch or wheaten flour may be substituted for the water with benefit, on account of the astringent properties possessed. Strict cleanliness, warmth, and ventilation are all most necessary. Exercise should be entirely discontinued.

Scouring in Young Calves.—We have above briefly discussed a disorder in calves which arises from indigestion, and may bring on diarrhœa. When calves are being weaned, too, they are very liable to diarrhœa, and, being weak, are not always able to control and overcome it. Moreover, when a calf is subjected to exposure, extremes of temperature, moisture, want of cleanliness, and so on, especially during the first few days of life, this scouring, and, indeed, many other disorders, are liable to come on. The first milk of the mother, which is called the colostrum, is so constituted as to be capable of removing all the matter which has already accumulated in the digestive canal; but many persons dispose of this milk. In such cases it may be necessary to administer two ounces of linseed or of castor oil, and then one ounce daily for a few days. Again, the milk of the cow may be deteriorated so that its effect upon the calf may be more or less injurious, and may bring on scouring. Sour milk, or that which has remained too long in the udder, should be scrupulously rejected, and calves should be fed regularly, and most carefully seen after.

When there are many confined together, calves have a habit of licking one another. Hair-balls are formed in this manner, and hence indigestion and diarrhœa ensue. Foul air, dirty or wet bedding, cold and damp states of the weather, and all mal-hygienic conditions should be especially guarded against in the case of all young animals. Manifestly the cause or causes should be removed, and the food-supply must be carefully attended to. If it is practicable, a calf suffering from diarrhœa should be put to another cow. If it is being reared by hand, great care must be taken that the calf does not feed too quickly, or take in air at the same time.

It is advisable to give in severe cases one or two fluid drachms of tincture of opium in addition to two fluid ounces of linseed oil. As we said above, alkaline solutions may be useful for softening the hardened masses in the stomach. A good draught for diarrhœa in calves, if it is due to indigestion, may be made of pepsine (twenty grains), of diluted hydrochloric acid (thirty minims), and of sulphate of cinchonine (seven and a half grains), together with a sufficiency of water. This may be given twice or thrice daily in mucilage of starch. If indigestion is not suspected, the following may be tried :—Diluted

sulphuric acid (thirty minims), tincture of catechu (two drachms), spirit of chloroform (thirty minims), given in mucilage of starch or in water three or four times daily. Should the liver be much affected, as may be shown by a yellowness of the membranes, it will be wise to prescribe two or three grains of Hyd. cum Cretâ (mercury with chalk), suspended in solution of starch or in mucilage of gum arabic.

Astringent enemas are valuable, and should contain a little opium as may be necessary. If the belly is swollen and tense, mustard or strong solution of ammonia should be applied to the side, and sulphite of sodium may be tried in doses of about half-a-drachm. In some cases of scouring in calves Mr. J. B. Gresswell has found the salicylate of iron a useful preparation. However, the salicylate of bismuth is probably of still greater efficacy.

It is well to add that it is often a difficult matter to account for scouring in calves, and the farmer will do well to seek advice, since otherwise he may lose very many. Those which are only affected mildly soon get better, since a dose of carefully-prepared astringent medicine will cure them. For obstinate attacks innumerable remedies have been tried, and what will suit one attack may not be effectual in others. Brandy, starch, boiled milk, may often be found useful adjuncts. In all cases the most careful nursing is indispensable, and the great loss which would otherwise occur can be almost entirely obviated, if the veterinary surgeon's treatment is backed up by unremitting attention. The difference in regard to treatment can be illustrated by the fact that in some cases it may seem advisable to administer alkaline solution, and sometimes diluted acids. If the presence of clotted milk in the stomach, almost resembling a piece of cheese, is suspected, the best plan no doubt is to aid the animal to digest it by the help of some such prescription as the first above-mentioned ; but great discretion is requisite, and no hard and fast rules can be enunciated.

DYSENTERY.

Diarrhœa, when continued for a long time, is very liable to end in what is called dysentery, a disorder which we shall now briefly consider. This name is given to the disease which

manifests itself by inflammation of the lining membrane of the large intestines. It may be accompanied by ulceration. Dysentery may follow neglected diarrhœa or such as is extreme or protracted, or it may result from the taking of unwholesome food, or from exposure to cold, or from placing animals in wet or badly-drained meadows, as a culmination in some cases of scrofula, as a complication of certain other diseases, or in consequence of the ingestion of some kinds of poison. The disease

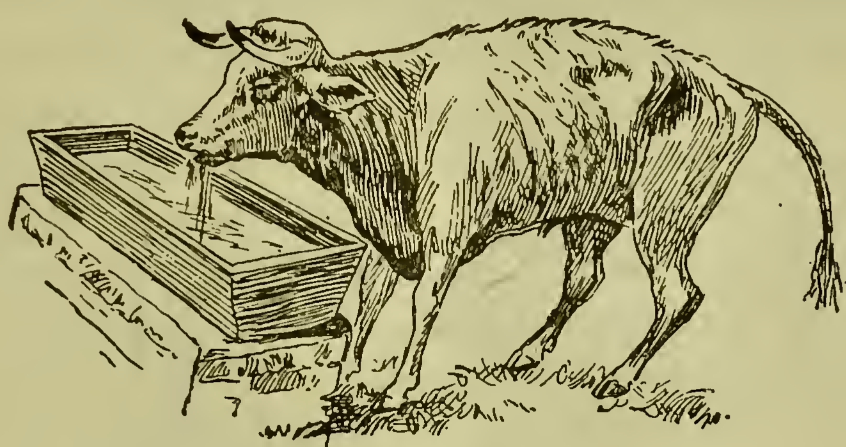


Fig. 69.—An Ox in a rather late stage of a severe attack of Acute Dysentery.

In the above illustration, a beast suffering from acute Dysentery, and evidently so enfeebled that it can stand upright only with much difficulty, is depicted. As not unfrequently occurs in the case of animals afflicted with this disease, this particular ox is represented as being very thirsty, and in the act of drinking as eagerly as its weakened and debilitated condition will allow—an indulgence for which the poor creature must probably ere long fall to the earth and pay its last debt to Mother Nature. In the picture the back is seen to be arched, the tail is held away and at a distance from the body, the ears are drooping, the eyes half-closed, the flanks and the belly are very thin and display what is sometimes designated a "tucked-up" appearance, the hair stands upright on the skin, the outlines of some of the ribs may be observed, and altogether the general look might be taken as a true presentment of disease and emaciation and pain to which all animals, and human beings also, are unfortunately liable to be subjected.

may be acute or of a more chronic character. If it is acute, there is fever together with slight abdominal pain, and the animal stands with arched back, constantly straining, and passing a small quantity of watery material tinged with blood. There may be vesicles in the nostrils. The signs of abdominal pain may increase in intensity, bring on rapid emaciation, sinking, and death.

Now, if the malady should take on a milder and consequently more chronic character, the animal becomes extremely debilitated, hide bound, and probably œdematous, the coat is dry and

staring, the mucous membranes are pallid, the ears pendulous, the eyes dull and glassy and sunken, the rectum protrudes, and from it flows a slight amount of bloody discharge; the back is arched, there is pain on pressure of the loins, and the animal staggers in the gait; the feces are tinged with blood, and very offensive.

In the case of *sheep*, dysentery is a dangerous malady, even from the outset of its course; whereas diarrhœa, on the contrary, only seldom seems to be very fatal to sheep, unless, indeed, it is assuming, or about to assume, the characters of the former

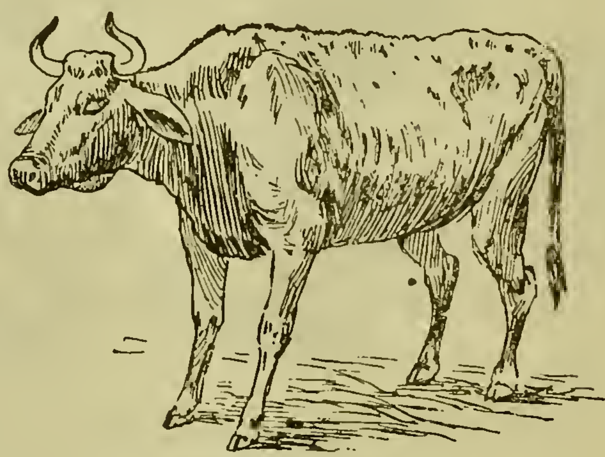


FIG. 70.

The above picture represents an ox suffering from Chronic Dysentery. The animal in this state may live for a rather long time, although its extreme emaciation renders it a miserable object. Every bone almost may be seen through the skin, the animal can only move with great difficulty, the eyes are sunken, and the space between the jaws may be filled by a swelling, the result of dropsy. The hair stands erect, the ears droop, and the beast presents an appearance of extreme dejection and misery.

disease. Dysentery breaks out most especially among older sheep, particularly in hot and sultry weather, or when they are present in too great number on scanty pasturage. The early stages of the disease are accompanied by febrile signs, and wasting and debility rapidly supervene. The complaint is characterised by the belly being drawn up, and the appetite lost. The animal wastes and dies rapidly, unless, indeed, the malady be checked by the aid of good medicine and warmth. The chief symptom manifested is a frequent discharge of shiny or green matter, which at a later stage may be mixed with blood. This discharge is thin and adhesive in nature, in consequence of the fact that a great deal of mucus mingles with it, making it cling to the wool of the tail and the thighs; sometimes, indeed, the tail may be, so to say, glued down.

If the disease should proceed in its course unchecked, the muscles of the loins and other parts will waste; and, indeed, the suffering animal will soon present somewhat the appearance of a living skeleton. In some cases the animal will eat with a certain degree of heartiness; but far more frequently the appetite will altogether fail. If the wool is pulled, it comes off, so slightly is it bound to the skin. Shortly before death, what has been called the black scour comes on, the discharge being mixed with dark gangrenous material resulting from the decomposition of the intestinal walls. Death may occur in the course of even a few hours, or the animal may linger on in suffering for as long as six weeks, and then fall a victim.

The treatment of oxen suffering from dysentery may not be very satisfactory, and after death the stomach as well as the intestines may be seen to be involved. The lining membrane may be reddened, and there may be a gelatinous effusion into its substance. The small intestines also are reddened, and the large intestines show spots of extravasation, are bluish in colour, and more or less deeply ulcerated.

Mr. Armatage, a well-known writer, suggests treatment by means of subcutaneous injection. Powerful astringents should be tried, and also astringent enemas. Carbolic acid, chlorinated lime, and hyposulphite of sodium have all been recommended in suitable doses. The animal should be carefully attended to, and supplied with dry and nutritious food which has been selected with judgment. The administration of calomel combined with opium has been attended with good results.

In regard to the treatment of *sheep* afflicted with dysentery, the first point is that the sheep should at once be removed from the situation and from the food which probably excited the complaint and still keeps it up. The food should consist of mashes and gruel, together with a small allowance of good hay at night. The patient may be placed in a tub of hot water, to which a very little antiseptic has been added, such, for instance, as a small quantity of salicylic acid, and allowed to remain therein for about fifteen minutes. When the tail is fastened down, warm water and carbolic acid soap should be plentifully used, and perhaps some of the wool must be cut away. If there be any sores, some powdered chalk should be sprinkled over them, or they may be dressed with some antiseptic ointment such, for

instance, as that of carbolic acid or that of salicylic acid, or with lard, with which a few drops of spirit of tar have been well mixed. Then the sheep should be thoroughly dried, and kept warm by wrapping, and placed in a comfortable and clean shed. One fluid ounce of castor oil, together with about thirty drops of laudanum, mixed with a little gruel, may then be administered, smaller doses may be given at intervals, and also a great deal of gruel nicely prepared, with different ingredients or different proportions of ingredients, so as to tempt the appetite by means of variety.

If it should be necessary, the dose of castor oil may be repeated, or it may be more advisable to have recourse to the astringent medicine spoken of under the heading of Diarrhœa, though it is best to add to it a great quantity of ginger and some gentian, and small doses of the mixture may be given every day for three or four days. When a sheep is on the way to recovery from this complaint, and the appetite is being regained, the diet may be gradually changed by the addition of a little mixed food, such as hay and vegetables. It will also be well to allow the convalescent sheep to graze on a wide pasture, but only for a few hours each day.

ENTERITIS, OR INFLAMMATION OF THE INTESTINES--PERITONITIS, OR INFLAMMATION OF THE PERITONEUM — ASCITES, VOLVULUS, INTUSSUSCEPTION, RUPTURE.

The rather formidable array of diseases which heads this division of our subject is in reality not of very much moment so far as oxen or their owners are concerned. In fact, in dealing with the diseases and disorders of oxen, one cannot fail to be struck with the idea that while some are of momentous and intense interest and importance, others, on the contrary, seem to be scarcely worth very serious attention, except by specialists. This is a great thing to say, and it is a point which will bear the most emphatic reiteration, viz. that the attention of men should be drawn more and more closely to those questions which we have laid stress upon in preceding pages, questions, that is, regarding the communicability of certain diseases of animals to the human race. However, we must not linger on the way, but proceed straight to the point.

Enteritis or Inflammation of the Lining Membrane of the Intestines.

This disease is, fortunately, very unfrequent indeed among oxen, and when it does occur, it is most generally working oxen or cattle which have been subjected to unusual conditions that are afflicted. Enteritis may manifest itself in adults of plethoric habit, coming on after exposure to inclement weather, or as a consequence of drinking cold water when perspiring. The disorder may also arise from the administration of a large amount of a drastic purgative, especially such a one as sulphate of magnesium or sulphate of sodium, each of which mainly acts upon the lower bowel, or from the ingestion of any irritant substances. It may be due to volvulus, intussusception, or engorgement. The comparatively harmless disturbance of the bowels called colic may, if it is not checked, lead on to the serious disease, enteritis.

Symptoms.—In cases of inflammation of the intestines, pressure on the abdomen or on the loins produces pain. Frequently there may be a discharge of a small amount of dry feces, the constipation being due to the fact that the muscular coat of the intestines is not able to contract and so move on the contents towards the seat of expulsion. Towards the end, there may, perhaps, be a little stream of very offensive liquid excrement which has forced its way through the hard mass of feces by which the rectum is distended. Acute febrile symptoms supervene; the patient stands obstinately in one place with its muzzle protruded; the hind limbs become weak, respiration is quickened, tremors occasionally come on, the animal is excessively thirsty but has no appetite, moans, grinds the teeth, looks round at the right flank, which seems to the poor creature to be the seat of pain or injury; the rectum is hot; and, finally, enteritis may be distinguished from colic, inasmuch as the pain is continuous instead of being intermittent, as in the case of that generally more harmless disease. While saying this, we should also caution the reader not to think colic an unimportant disorder. So far from this being the case, it might be held that, if all cases of colic were properly taken in hand, there would be far less enteritis, this latter disease often succeeding the former, if unnoticed or neglected.

The disease very often ends fatally, and with rapidity. Towards the close, the animal's extremities become very cold; the pulse, which before was quick and small and wiry, is now almost imperceptible, the temperature falls rapidly, the animal becomes unconscious, and, with many moanings, falls down to the ground and dies.

After death, if the belly be opened, the intestines both small and large may be seen to be distended with gas, and the peritoneum (the membrane which connects the bowels and keeps them in their places) is inflamed, or perhaps even gangrenous. The walls of the intestines are thickened, and they also may be reddened by congestion or present a greenish hue, characteristic of gangrene. Between the muscular fibres there is a gelatinous effusion, and inside the bowels blood and mucus may be observed.

With regard to the treatment of animals suffering from enteritis, it must be prompt. If the patient is full-blooded, blood must be taken away at once, and, if necessary, in six hours' time the bleeding should be repeated. As much as a gallon of blood has been abstracted in some cases. The belly should be stimulated by means of hot rugs wrung out from hot water, renewed at intervals, and by liniments. Great benefit may accrue from doses of thin warm gruel containing a little linseed oil. Opium is a most useful drug for allaying the pain; but aconite in suitable doses is perhaps better, if the constipation is severe. Cathartics, if given, produce great mischief in this complaint. Most careful nursing is necessary. The impacted feces may be removed from out the rectum manually or otherwise, and anodyne and mucilaginous enemas may be very advantageous. The animal may be allowed to assuage its thirst from a supply of nitrated water placed conveniently by its side.

Sometimes one may be told that an ox has expelled a "snake." In reality the so-called snake is a fibrinous cast of a portion of the intestinal canal, flaky on the surface. This may occur in a kind of enteritis not so severe and acute as that above described, and called croupous enteritis. After the "snake" has been discharged, recovery generally takes place.

In the first instance this disease, as manifested in sheep, is very similar to colic. After the initial symptoms are over, the animal stamps and scratches the ground with its feet, tries to

strike its belly with the hind legs, bends its knees, as if a preliminary to the process of lying down, but apparently dreads the pain involved in so doing, looks round at the sides, falls down suddenly, rolls on its back, and then suddenly starts and scrambles up again. The extremities, horns, and muzzle are cold, the pulse is quick and small, the bowels are obstinately constipated, and the disease is so debilitating that the afflicted animal becomes greatly emaciated. The animal is quite regardless of all surrounding things, the pupil is widely dilated, and delirium may supervene.

Should the animal die, and the intestines be examined after death, intense inflammation of the peritoneal coat of both large and small intestines may be seen. This inflammation may sometimes extend from the cæcum to the abomasum, sometimes also to the other three stomachs, and the liver may also be affected. The disease is occasioned by too much food or by stimulating food, by the administration of purgatives, and especially by the combined influence of cold and wet. Sometimes, by way of treatment, bleeding may be found useful, and Epsom salts may be administered and followed up with sulphur. The food may consist of mashes, or gruel. If the constipation is followed by diarrhœa, then, and not otherwise, may tonics be administered.

Acute Dropsy or Redwater in Sheep.

It is very difficult indeed to say what is the cause, or rather what are the causes—for no doubt there are several—which determine the onset of this suddenly fatal disease. Some practitioners think that it is brought on by a deficiency of iron in the system ; and, whether this be true or not, it certainly does appear to be an indisputable fact that the administration of iron in suitable doses and in a proper manner does work an immense amount of good. The name "redwater," though very commonly used, is not really a very suitable one, inasmuch as it is liable to lead to confusion, being also applied to a disorder of sheep in which those animals discharge red-coloured urine. Redwater is very commonly met with among lambs soon after they are weaned, especially if they are allowed to lie about on a moist and chilly soil. If the malady is detected early enough, it will generally be found best to send the animal to the butcher.

The disease is very well known to those who have to do with sheep, and the losses are in some parts occasionally great, as, for instance, in certain parts of Lincolnshire. It is in the autumn or the beginning of winter, when the sheep are on the turnip fields or are feeding on other very succulent food, that redwater usually breaks out. Although on the preceding night all the sheep of a flock were apparently well, the shepherd may nevertheless find, when the morning dawns, one or more lying down, almost in their usual posture, with their legs bent under their bodies, and their heads inclined forward, but dead. Frequently it may happen that a change of pasture, and especially a change from a dry to a cold and wet one, and particularly if there is much hoar frost, may bring on this disease ; for, when such is the case, the belly comes into contact with the cold and damp ground, whereby chilling and inflammation of the peritoneal coat of the intestines is produced, and a great deal of fluid accumulates and becomes red and bloody as a result of the rupture of the small vessels of the peritoneum.

If after death an examination be made, the belly is found to contain a variable amount of a sanguineous fluid, while the peritoneum—especially the mesenteric and omental portions of it—is seen to be much inflamed. This disease, then, in which inflammation of the peritoneum is the marked characteristic, is what we mean by redwater, and it must be most carefully distinguished from other diseases bearing the same appellation. Certain disorders of both sheep and cattle, of which the leading symptom is either the excretion of blood-coloured urine or the presence of a sanguineous fluid in the abdominal cavity, distinct from the disease above described, also sometimes go by the same name. For example, the name redwater has been bestowed upon a condition in which jaundice manifests itself, the urine also at the same time being of a port-wine colour, and the animal showing anæmia in a marked degree, having a pulse of one hundred and forty per minute, while the heart-sounds are loud and the respirations quick. When suffering in this way, an animal dies as a result of exhaustion, and after death the tissues of the body may be seen to be pale and yellow, the blood being scanty and the liver softened. Nutritious food should be supplied, and both mineral and vegetable tonics may be administered. Salts of iron seem to be especially advantageous, the

sulphate of iron being very valuable in doses of about fifteen grains. In Ireland, redwater is said to prevail widely.

Moreover, Mr. Gowing has recorded that the disease broke out on a farm in Middlesex in sheep kept on good and rich grass land. This occurred in the year 1849, and during that same year there were, and since then there have been, many outbreaks. Occasionally the mortality is very great. On visiting the sheep early one morning in April, two lambs were seen to be unwell, to stagger in their gait, to separate themselves from the others, to be dull, and to hang their heads low. Their mouths were closed so firmly that the jaws could scarcely be opened, and a frothy saliva covered their lips. A small quantity of castor oil mixed with some warm milk was given to each lamb, and, as they appeared to be a little better a few hours afterwards, they were again put with the ewes. The bowels having been opened, the lambs gradually recovered ; but they remained very weak for several days.

In the beginning of May, an ewe exhibited symptoms similar to those which the lambs had previously shown ; she was also considerably hoven, and also breathed with great difficulty. A full dose of castor oil was at once administered. In the early afternoon the oil was repeated, and later in the afternoon a saline aperient was given, but the ewe died while taking it. When the body was opened, the paunch burst from the pressure of the great mass of food contained in it. A few days afterwards a lamb, apparently well at noon, was found dead about 4 P.M., and on the third day afterwards another also was found dead. Two days after this a third lamb was taken ill. To this a dose of castor oil was given, and it was bled in the eye-and-ear-veins. The blood was very dark, and flowed slowly. The lamb's breathing was laboured, and at intervals ceased for several seconds. It died on the following morning. Examination after death showed that the liver was larger than is natural and darker than usual, the lungs slightly congested, and in each pleural sac there was a small quantity of limpid fluid. The pericardial sac likewise contained about two ounces of fibrin and serum. The fibrin was in a state of semi-coagulation. The external surface of the heart, especially on the left side, was studded with dark spots.

The sheep were then turned on to a common where the

herbage was scanty and where they could roam at freedom. On the next morning, however, another ewe was found dead. When the body was examined after death, the belly was found to contain a large quantity of sero-sanguineous fluid, and all the viscera were congested, some being nearly black. The venæ portæ and the contiguous portion of the posterior vena cava in the belly were distended with coagulated blood. The spleen was greatly enlarged. The biliary ducts and the gall bladder were full of bile, and the liver, as in the lamb, was large and dark coloured, owing to its vessels and ducts being full. The lungs were greatly congested, and the heart was very large. Both the right auricle and the right ventricle contained a great amount of coagulated blood, which indeed was also present in the large vessels going into and issuing from them, most especially the anterior and posterior venæ cavæ and the coronary veins. The right auricle, when freed from its contents, also showed ecchymosed spots in its muscular structure, beneath the lining membrane. The left side of the heart contained only a little black blood.

With regard to treatment it may be said that sulphate of iron seems to be in certain cases one of the best remedies. By way of prevention, a constant supply of salt, either given with chaff or in the form of rock-salt placed in troughs has been recommended. Another writer advised one ounce of salt, a quarter of a pint of water, and half a tablespoonful of turpentine. This might be well mixed in quantity for the number, and should be freely shaken before being used.

The late Professor Robertson recorded that the shepherd may at times remark that "this or that lamb cannot live, it is pocking at the navel." The belly is pendulous, as a result of the presence of a turbid fluid in the peritoneal cavity. Shreds of fibrin float in this fluid. The umbilical cord is greatly enlarged, it is soft, flabby, and has its vessels filled with dark blood. Instead of the development of the ligamentous cord extending to the liver, a chain of cysts is developed extending from the umbilicus to the liver, and these cysts contain pus mixed with tubercular matter. The liver, too, shows pustular and tubercular growths, as also do the omentum and mesentric glands, owing to which the belly comes to contain a purulent serous fluid, and to become pendulous. It is really often the best course to have

sheep thus afflicted slaughtered without any delay. In the study of some of these affections it is very possible that sufficient attention has hitherto not been given to the condition of the kidneys.

Navel-ill in Lambs.

There is a rather peculiar disease in which the navel is often involved called Navel-ill, often characterised by external swellings, and occasionally met with in lambs. Strange as it may seem, this disease has been most prevalent when the season

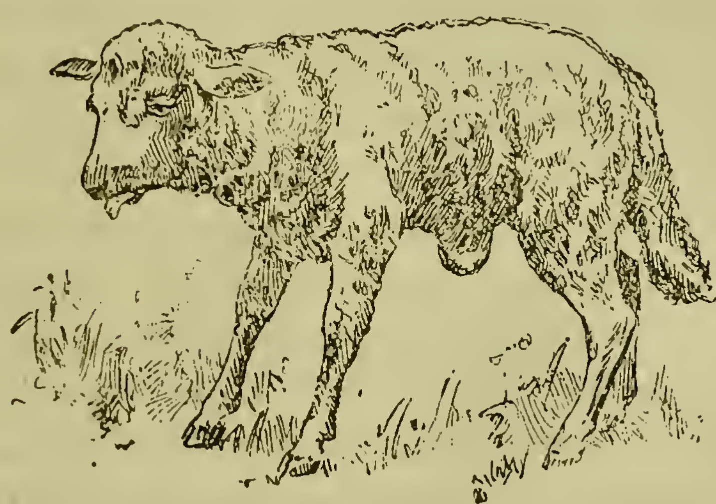


Fig. 71.—Navel-ill.

The above picture represents a lamb afflicted with the disease known as navel-ill. The most characteristic point about the little animal is that its navel is seen to be much swollen and enlarged. The tongue protrudes, and the little creature shows a certain look of helplessness and bewilderment, and almost looks, so to say, as if it were bleating: "Whatever is the matter with me? I do wish someone would cure me."

has been remarkable for the good condition of the ewes, for the large number of the lambs, and for a plentiful supply of good food. Even as many as twenty out of a flock may die of this disease within the first fortnight, or even the first week of the lambing season, and we do not find, as we might expect to do, that the deaths diminish in number in proportion as the weather becomes mild and the grass improves in quality. It is difficult to say what are the actual causes of the disease, but it seems that flocks which have been kept in confined quarters during the winter are frequently affected.

When afflicted with this disease, the lambs suddenly stagger, and look debilitated and drooping. The bowels may either be constipated, or the opposite condition may be manifested. The

navel is swollen and flabby, and the eyes have a yellowish hue. The patient is not capable of standing; but, if lifted up to its dam, it will suck. The result of the malady is that the lamb will dwindle away and die—unless, indeed, effectual remedial measures are applied—perhaps even in a few hours' time, or perhaps after a week or so. After death, if an examination be made, dark blood will be found present in the viscera, the umbilical veins will be swollen, the liver engorged and studded with abscesses, and the tissues of the body frequently yellow.

By way of preventive measures, the flock should at once be supplied with a diminished quantity of food, and either aperients or neutral salts, especially those of an antiseptic nature, such as the sulphite or the salicylate of sodium, may be tried in suitable doses, and these remedies should be given to the ewes as well as to the lambs. The most important point is that only a moderate supply of food should be given to the ewe, it being very requisite that the condition of the animal should be maintained without there being any excess of fat internally, or any undue richness of the blood. Indeed, this question of over-indulgence in food is one of great moment, and, in fact, is as important in the case of animals for their welfare, as it is in that of man himself, for his.

It is nothing like sufficiently realised that a great many of the evils to which living beings are liable are due to errors in dieting, and there are many men and women, as well as lower animals, who bring themselves to an early and premature grave by that single excess. We need not say, for it is now being preached, so to say, from the house-tops, how necessary it is that men should avoid indulgence in alcoholic drinks; but in passing we may just remark that these two evils of over-drinking and over-eating account for a very great deal of the sufferings with which human beings are afflicted. Very closely coupled with this important consideration is the advisability that a due amount of exercise should always be taken by all kinds of living beings. There is little or no danger that animals running wild in the natural state will not have sufficient physical activity. In the state of domestication, however, and far more markedly in that of human civilisation, there is room for the greatest fear in this respect. A highly-educated man usually lives purely on the financial results of mental work. In fact, instead of actual

movements of his body, in consequence of his own exertions through space, it is the complex molecules of his brain which, in virtue of their rapid and strong vibratory oscillations, produce large and actually visible motions of a more simple kind in other human beings.

Many persons in these days who know how to use the resources of civilisation without any great means produce results, when quietly sitting in their rooms, the magnitude of which even they themselves are far from realising. However, every action is coupled with a re-action, and it is a mournful and sad truth that, as Goethe has expressed it, action kills thought and thought activity. Leaders of men produce gigantic results, both by spoken and by written words ; but they oftentimes do it at great cost. It cannot be too vehemently emphasised that all the organs of the healthy body may be kept in a state of activity by means of appropriate and well-regulated exercise.

We have, however, been digressing from our subject, and must therefore now conclude with the practical remark that it is advisable that ewes, even after they have been drafted out in the order in which they will lamb, should be made to move about gently now and again, in order that they may not altogether lapse into inactivity. We may add to this the far more important observation that those men who are engaged in mental pursuits should on no account ever allow themselves to desist *entirely* from health-giving out-of-door exercise. The warm weather is, as we write, coming on, and all of us who feel ourselves getting into bad habits of this order should now and again shake off the chains which bind us to the office or the stool, and spend an hour or two in the country lanes and woods, among the primroses and the violets and the refreshing buds and breezes of this genial and sweet season of the year, and watch the merry gambols of the lambs, now rapidly advancing towards maturity, and the sober demeanour of their patient mothers, as they slowly chew the cud, while we indulge in the musings engendered of sweet fancy.

Peritonitis.

Peritonitis is the name given to a most serious disorder, viz., inflammation of the membrane which lines the cavity of the

abdomen, and invests more or less completely the whole of the intestines and stomach, the liver, spleen, kidneys, and other organs contained in the abdominal cavity. Though rather frequently met with in the horse, it is fortunately very rare in the ox, sheep, and pig. The disease generally comes on after wounds of various kinds; such, for instance, as that produced by the passage of sharp foreign bodies from out the stomach to the neighbouring structures, or that occasioned by the operation of rumenotomy or other similar operations in which the inflammation is produced as a result of the accidental contact of foreign material with it. The animal suffers pain, is dull

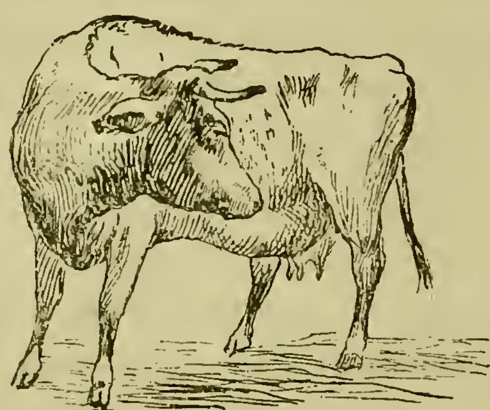


FIG. 72.—PERITONITIS.

In the above illustration a cow afflicted with Peritonitis is depicted. The animal is seen to be looking round to the flank, as if to see whence proceeds the cause of the pain endured; yet the inquiry seems to be without satisfactory result, and the poor creature appears dismayed and puzzled, and resigned to its sufferings.

and anxious, looks round occasionally at its flank, moans, grinds the teeth, paws the ground with the fore-feet, shivers repeatedly, especially in the region of the hind-legs and flanks. The bowels become constipated, the pulse is hard, and the extremities are cold, and become colder as the disease advances, the chewing of the cud is suspended, the appetite is lost, the bowels are acutely constipated; but this stage may be followed by a profuse, watery, and perhaps even bloody diarrhœa, the belly is swollen, tense, and tender, especially near the injured part, the urine is scanty in amount and high-coloured, the pulse is hard, frequent, and wiry, the breathing is quick, laboured, and thoracic, the diaphragm (the wall which separates the cavity of the chest from that of the abdomen) being fixed as much as possible, on account of the pain which the least movement of it causes by reason of its action upon the inflamed peritoneum.

The pulse becomes softer, weaker, smaller, and more rapid, the breathing slower and less painful, the watery portions of the blood accumulate within the cavity of the abdomen, there is less pain, but the animal is really worse. The belly is fuller, the mucous membranes are pale, the eye is sunken, and the animal crouches with all four feet drawn close together. Finally, the pulse becomes imperceptible, the temperature falls suddenly from about $104\frac{1}{2}°$ F. to about 96° F., the animal falls down, and death ensues within about four and a half days from the first appearance of signs of the disease.

If an examination is made after death, as the walls of the abdomen are opened, a milky or sanguineous straw-coloured fluid flows from the belly. The peritoneum, especially near the seat of injury (if there has been one), is red, opaque, and hidden by deposits of lymph which bind together the different abdominal organs.

In regard to treatment it should be the same as that for enteritis. Cathartics must never be given. Opium is most useful both as alleviating the pain and as checking the peristaltic action of the intestines which brings on the pain. The abdomen should be blistered. Enemas should be given every four hours until the bowels are well opened, and if the animal becomes very weak, nutrient enemas should also be given. Bleeding should not be resorted to.

Ascites or Dropsy of the Abdomen.

This term has been applied to the state of an animal in which fluid is present in the abdominal cavity in consequence of peritonitis. It is, however, more correct to apply it only to cases in which such fluid is present quite independently of inflammation of the peritoneum. This disease is the consequence of general debility or of mechanical impediment to the return of venous blood to the heart, occasioned perhaps by diseases of that organ or by disease of the liver, and also by the pressure of a tumour upon the vena portæ. The disease is not frequent in the adult, but often occurs in the fœtus, probably as a result of debility of the parent. The best plan in some cases is to cut by the aid of the concealed knife through the abdominal walls of the fœtus, and so let the fluid escape.

In the case of this disease appearing in the adult, the belly is distended, and if one hand be placed against the abdominal wall, while the opposite side of the abdomen is percussed, a wave of fluid may be detected. Dropsical swellings appear on the belly and under the chest. The respiration is thoracic in character, and the animal becomes gradually more and more anæmic.

The treatment must be adapted to the removal of the primary cause of the complaint. The strength must be sustained with stimulant tonics. Many remedies have been tried, but with very doubtful success. Spirit of nitrous ether lowers arterial tension, and, by relaxing the renal vessels, it acts as a diuretic, and it also has a diaphoretic action on the skin. The dose is about two fluid ounces. Water should only be allowed in small quantities. Salts of iron given alternately with vegetable tonics or digitalis, which is useful as a sedative and for its action on the kidneys, may be tried by the veterinarian. Probably he may in some cases think well to tap the belly, using a small trocar-and-canula, and making the puncture midway between the umbilicus and the iliac bone, the instrument being inserted gently. The reason why the fluid is not absorbed naturally is that the stomata of the peritoneum are plugged with lymph.

We now proceed to deal shortly with various disorders of an allied nature.

Imperforate anus occurs most frequently in calves. Sometimes the anal opening is closed up with skin. Sometimes the anus itself is perfectly formed, but at a little distance from the external orifice there is a membranous partition. Sometimes the large intestine may terminate in a *cul-de-sac*. In its efforts to discharge the rectal contents, the young animal strains violently. If either of the first two conditions is present, the best plan is to divide the membrane by means of two crucial incisions. If, however, the intestine ends blindly, an attempt may be made to reach the blind end and open it, and then to sew the edges of the opened end to the edges of the cutaneous incision.

Mechanical distention of the rectum with hard pellets of meconium is sometimes so serious a matter as to necessitate the removal of them either by means of the oiled forefinger or in any other suitable manner.

Piles or hæmorrhoids are tumours situated in the terminal

portion of the rectum, or near the anus, and caused by a varicose condition, generally, of the rectal veins. They give rise to pain during the act of defecation, and protrusion of the anus, and the feces are tinged with blood. They seem to be occasioned by habitual constipation, or by disorder of the liver. Sometimes they may be removed by ligature or otherwise. The food should be soft, and laxatives may occasionally be administered.

The displacement known as prolapsus ani differs from hernia, in so far as the protrusion occurs through the natural opening afforded by the anus, and consists in chief part of mucous membrane. It results from violent straining occasioned by intestinal obstruction, by labour pains, or by obstruction to the outflow of urine. After the rectum has been protruded, it will probably become strangulated, take on a bright red hue, and subsequently become very much enlarged owing to effusion, and then cold and of a purple colour.

The cause of straining should be obviated, and the bowel should be well washed with cold water, and, if possible, carefully returned by pressure. If the portion protruded has become purple, amputation of it may be resorted to, the edges of the two cut portions being united together by sutures. After he has operated, the veterinary surgeon will probably prescribe some suitable sedative, such as opium. Soft food only should be allowed until recovery has taken place.

Volvulus or twist of the bowel sometimes comes on as the result of violent struggles during the intense pain of colic. The abdomen may be opened by a skilful surgeon, and the intestine operated upon. The seat of incision is about opposite to that for rumenotomy, and on the right side; but the operation is only to be resorted to as a last resource, and even nine owners out of ten would prefer slaughtering.

Intussusception, or invagination, is the name given to a folding of one portion of intestine—generally near the cæcum in the case of the ox—within the canal of another portion. It is rare in the ox, and comes on from colic. Operations have been performed with success in these cases.

Rupture.

By the term hernia, or rupture, we understand the protrusion of some of the contents of the abdomen or belly out of their

proper containing cavity. The varieties of rupture are acute or sudden, and chronic or congenital. Chronic rupture is congenital, the young animal being thus affected at its birth.

The form of rupture to which we first draw attention is called umbilical. In this condition the bowel has protruded through the navel, forming a tumour of varying size at this spot, and one often meets with it in newly-born calves. Rupture of this kind is easily cured. The young animal is cast on its back, the prolapsed bowel is pressed back into the abdomen, the loose skin is then brought together, and round it is drawn tightly a piece of stout cord. The skin, thus deprived by the ligature of any blood supply, sloughs off, while the raw sore soon heals and a permanent cure is made.

The second form of rupture, to which we call attention, is termed ventral hernia, by which term we mean the protrusion of the intestine through the abdominal walls at other parts than at the navel. This form of rupture, as might be expected, is unfortunately not very uncommon, resulting as it generally does from injuries, such as blows, &c., on the belly.

Many of these cases are unfortunately beyond our power to cure, excepting where the tumour formed is not very large, and is not situated in the most dependent part of the abdomen. In the cow it is not advisable to attempt any means of curing ventral hernia, or "broken body" as the affection is commonly called; for it is far preferable to have her fed up and slaughtered. As a rule, an animal with ventral hernia shows no sign of uneasiness, excepting shortly after the infliction of the injury which has severed the muscles of the body.

If the tumour be not very large, in which case only treatment is of any use, and it be desirable to operate, the animal is prepared several days beforehand by being fed upon a most restricted diet and the administration of a dose of physic. On the day previous to the operation, no food is allowed. After the animal is cast, and chloroform duly administered, the skin over the rupture is divided from one end to the other. The edges of the divided muscles are then brought into view; these are brought together and secured by means of stitches of stout silk, and then the edges of the skin are similarly brought together and stitched. A portion of tenax, or tow saturated with carbolic acid lotion (one part of carbolic acid to thirty of water) is placed over the

wound. Over the whole, a broad band or surcingle may be buckled tightly, and held in position thus for some time.

Of scrotal hernia, we need not say much, as, being only possible in the uncastrated animal, it is not very often met with. By scrotal hernia we understand the protrusion of the intestine into the scrotum—*i.e.* the capsule containing the testicles. The danger in these cases is of the intestine becoming strangulated, *i.e.* so constricted at the outlet through which it escapes out of the abdomen, as to prevent the circulation going on in it. Mortification thus ensues, if relief be not given. In ordinary cases the best treatment is castration, performed by the covered operation. In cases of strangulated hernia the danger is necessarily immensely increased, and treatment must be prompt, or death will ensue.

It is not always an easy matter to detect strangulation of the intestine in this part; but the symptoms in the main resemble those of inflammation of the intestines. In these cases the animal should be cast, the capsule of the testicles should be opened. Through the opening the finger is passed, and along the under surface of the finger a concealed bistoury is guided and the stricture is divided, so as to allow the return of the intestine into the abdomen.

We next proceed to consider the affections of the liver of the ox, their nature and treatment.

THE LIVER AND ITS AILMENTS.

We now have to deal with a subject which demands some special attention. There is no manner of doubt that it may be truly said, more especially, as might be expected, in regard to mankind, but also, though certainly in a less degree, in reference to the lower animals, that the diseases and derangements of that important abdominal structure known as the liver are of exceptional interest. True, it could not for a moment be maintained that this organ and its ailments are of anything like the same significance in their relationship to the lower ranks of animal life, as they indubitably are when considered in their bearings upon the well-being of man himself. No one, however, could exaggerate the advantages to be derived from a complete knowledge of liver diseases in the human subject. The maintenance of healthy life is one of the first essentials

on which we should ever keep a clear eye, and in these days the functions of the liver are especially liable to be impaired, so prone are we to indulge at once both in high living and in sedentary pursuits.

There are, in the case of the life of each one of us, many grave misfortunes to be apprehended, which can neither be foreseen nor guarded against, and hence it becomes all the more necessary that all those removable dangers which are liable to beset us should be avoided with the very greatest care. Some persons, it is to be feared, are apt to look upon life, with all its pleasures and its pains, too much from the standpoint of chance and luck —in short, to develop a fatalistic bent of mind. "What is the use," one thinks, "of bothering seriously about such minor disturbances in my bodily frame as a bilious attack, a fit of indigestion, or a simple cold, when at every touch and turn the terrible uncertainty of human life is most forcibly and horribly exemplified again, and again, and again!" The fact remains, however, that the philosophy expressed in the phrase, "What must be, will be," is erroneous and misleading, and though at first sight it may seem specious, it does not commend itself to the deepest and clearest thinkers. Indeed, the conduct based upon such ideas is most ill-suited to the exigencies of life. The rest of the world presses on, on and on, eager to eliminate all that is wrong and imperfect, and if we do not do likewise, we shall inevitably suffer, in so far as we fail in our duties to ourselves and to the world, and must be left in the lurch. Not only, then, is a knowledge of the disorders of the liver and, indeed, of all the organs of oxen directly useful in so far as it bears upon the welfare of stock, and therefore adds to the wealth of stock-owners, but it is also valuable, inasmuch as such information cannot fail to throw light upon the allied diseases which afflict human beings.

It is matter of general knowledge that the liver is one of those organs among ourselves which very frequently suffer disturbance and derangement in regard to their functions. The well-worn joke of *Punch* upon this subject would not bear repetition except for the intrinsic value and truth of the fact which it emphasises. "After all," gasps the melancholy-minded man, "is life worth living?" "Well," replies his friend, "you see it all depends upon the liver."

An inactive liver, whether in man or in animals, leads to all kinds of complications, of which by no means the least serious are those conditions of nervous depression, those habits of looking with gloomy eyes upon the black side of things, those mental self-torturings which cannot but make life burdensome, and altogether devoid of gaiety and happiness. Certain it is that many persons give way to feelings of despondency quite unnecessarily, often, too, when the wheel of Dame Fortune is just about to spin round to point favourably and bring prosperity to all who deserve it. Nothing is so damaging to the constitution, nothing so sure to bring failure in its train, nothing so likely to render confusion trebly confounded, the darkness fifty times more black, than is a miserable state of mind, the inevitable result of a clogged-up liver, especially if it be coupled with scant means.

Such a state is one of the many evils, or rather one of the many horrors, which men have to guard against. Hence we take this opportunity of repeating to those about to lose heart, to those who are sinking under burdens and well-nigh giving way, and *à fortiori* to those who have any idea whatsoever of committing either moral or physical suicide—" Don't—don't—don't! " *Per contra*, if it is at all possible to do so, pack up your portmanteau at once, and get away as quick as you can to the sea-side, or some invigorating place, even if it is only for a week, or even for the day. It is simply astonishing what benefit a plentiful supply of ozone will bring, and how it will enable a man to throw off a load of trouble. If you have occasion to suspect that the liver's wheels require a little oiling, never mind what people may think, but go on the sands, jump on a donkey's back, take measures to make the animal gallop if you can—that will make your liver work—and come back like a giant refreshed with an alcoholic stimulant.

There are many causes which may bring on torpidity of the liver in man. In the production of this disorder, a prolonged residence in tropical climes, sedentary habits and pursuits, and want of exercise, however arising, excessive or undue indulgence in alcoholic liquors, are all well-known factors. We are not now, of course, speaking of acute inflammation of the liver—to that we shall come in due course—but to that insidious affection of it which is of slow and gradual growth. The

yellowness of the skin and of the eyes, or a certain characteristic muddiness of complexion on the part of those who suffer from "the liver," too often tells a tale of misery and wretchedness.

It seems that a tropical climate brings about disturbance of the functions of the liver in large measure by a certain enervating effect which it produces, as well as indirectly by reason of the disinclination to exertion, or even to such an amount of exercise as is necessary for health. Many persons cannot withstand the great heat, and many have their constitutions permanently damaged by a protracted stay in such countries as India. The fact is that we English are accustomed to a temperate clime, and though we as a nation have perhaps more power than some other nations of adapting ourselves to altered conditions of environment, still many of us are liable to suffer greatly by too sudden or too extreme or too prolonged changes in our habitat. It is scarcely necessary to add that when habits of intemperance in regard to food or drink, or both, are coupled with a want of exercise and the great depression caused by a very hot climate, the results are most disastrous. It is also well known that major liver diseases in tropical climates are due to a pyæmic or septicæmic process resulting from dysentery.

Similar causes lead to similar results in the case of lower animals; but, before we go on to discuss the diseases of the liver in oxen, we will say a few words about that structure itself. The liver, the organ which secretes the fluid known as the bile, is large in the ox. It is situated in the belly, on the right side, between the third stomach and the diaphragm. Those who wish to understand clearly the anatomy of the organ should repair to a slaughter-house, and gain the opportunity of seeing the structures *in situ*. They should read up the subject first in some good book, and then go and look at the structure itself.

By so doing, if they are good observers, they will readily understand and rapidly learn more than pages and pages of mere description could teach them. The liver is divided into two main divisions, of which the right is larger than the left. The liver of the ox, like that of man, the dog, and so on, but unlike that of the horse, is provided with a gall-bladder, a bag-like receptacle in which the bile is stored up, in order that it may be used at the needful times. It is closely attached to the liver,

and by the medium of its neck or short duct it communicates with the biliary duct itself. Moreover, in the ox this short canal, known as the biliary duct, does not join with the duct leading from the pancreas as it does, for instance, in ourselves; but, on the contrary, it opens separately into the first portion of the intestines called the duodenum at a spot about two feet distant from the pylorus (the orifice of the stomach which leads to the small intestine). The gall-bladder of the ox is capable of containing several fluid ounces, and its duct (called the cystic duct) increases in size somewhat after its commencement. The bile stored up in the gall-bladder is liable to become inspissated, and to form biliary calculi, which consist of the bile salts, of pigment and cholesterin, are of about the average size of a walnut, and have so low a specific gravity as to float, if placed on the surface of bile. There may be a great number of them. During their passage through the central portion of the cystic duct and the terminal part of the bile duct, they cause excruciating agony, owing to the spasmodic contraction of the muscular fibres of the walls of the ducts. These pains may be inferred to be distinct from the pains of colic by the occurrence of some biliary calculi in the feces. A case of rupture of the gall-bladder has been recorded by Mollereau.

The blood which comes from the organs contained in the abdomen is collected together into one estuary, so to speak, by being conducted into a large vein, called the *vena portæ*, by means of which it is passed through the liver. Certain materials are abstracted by this organ, which, if allowed to accumulate in the blood, would cause disease. The bile may, therefore, be considered to be at once an excretion and a secretion, inasmuch as not only would the materials which compose it be productive of harm, if they still remained in the blood, but in addition to this the fluid aids the digestion of the fatty matter of the food. The bile is capable of dissolving fatty matters, and indeed an illustration of this is readily supplied by the well-known fact that ox-gall is capable of dissolving and removing spots of grease.

The most important disorder of the liver is ordinarily known under the name of jaundice or the yellows, and also as hepatitis, or inflammation of the liver.

Now both oxen and sheep are more frequently subjected to

disorders of this organ than is the horse. Indeed, it is not an uncommon occurrence for sheep to be afflicted with inflammation of the liver, and also for that disease to be attended with a fatal issue in the case of those animals. When they are thus afflicted, the sheep hang their heads down, look dispirited, partly refuse food, heave at the flanks, manifest unwillingness to move, and are constipated. They may display febrile symptoms, yellowness of the skin and of the eye, tenderness when pressed upon the right side, and lameness of the right fore-leg. This disease usually arises from excess of food, which leads to engorgement of the liver, which organ after death is found to be friable and broken down in texture. The remedial measures which may be taken consist in bleeding, in the administration of Epsom salts, and in the supplying of a spare diet.

In dogs the disease is usually very severe, and by no means readily amenable to treatment. In horses, too, great care and very good management are essential to success, though the disease is not very frequent among them. When it does occur in horses, the probability is that there is a general disturbance in the secretory functions, or a stoppage in the bile-ducts. The reader will remember that horses have no gall-bladder. Jaundice may be brought on by excessive feeding, or a want of exercise, especially in hot weather, or it may result from a sudden change of temperature, or an abrupt alteration of the food-supply, or from exposure.

Any cause which interferes with the secretion of bile, such, for instance, as the blocking up of the biliary duct owing to the presence of gall-stones or of thick and inspissated bile, to mechanical pressure on the duct or contraction of it, may bring on jaundice. The bile, being thus confined, is re-absorbed into the blood, which imparts a yellow tinge to all the tissues. The disease is very easily recognised. The skin and the mucous membranes present a yellowish or brownish hue; but we must not forget that a yellowness of the skin may also result from certain kinds of food, and, indeed, may show itself more or less normally in some of the best breeds of oxen. In inflammation of the liver the abdomen may be seen to be swollen, and if pressure is applied, great pain is thereby occasioned, the animal flinching, moaning, and grinding the teeth. The secretion of bile being greatly interfered with, the bowels are constipated,

and the feces are dry, hard, scanty, and buttoned, of a chocolate, clayey, or even white colour, and generally coated with mucus. The milk, if the patient be a milk-giving cow, is yellow and produced in small quantity, and the cream is thick and ropy. The animal may occasionally be troubled with pains like those of colic. The skin has a harsh and staring appearance, and is coated with a brownish matter. The urine is scanty in amount, frequently passed, and of a very yellow or deep-brown colour. In fact the kidneys and the skin furnish the channels by which the bile is conveyed out of the system. The number of respirations is increased slightly, and the pulse is soft, weak, and generally frequent, if there be inflammation, but otherwise slow. The animal is very dull, depressed, listless, devoid of energy, thirsty, and has a dry muzzle.

If the disease becomes chronic, and the liver enlarged, there is a great dejection and loss of condition, and a marked disinclination for exertion. It is then very difficult to cure. The animal may gradually succumb or be carried off by an acute attack of diarrhœa. After death the liver may be found atrophied, or much enlarged and softened (though softening of the liver is not very frequent), or containing abscesses. The peritoneal covering may show deposits of lymph. In regard to treatment, it is well to stimulate, or in some cases to blister, the region of skin corresponding to the seat of the diseased organ. For this purpose mustard and turpentine or the tincture of croton may be used.

A simple saline cathartic will be found beneficial, or a drench made of about twelve ounces of solution of aloes, six ounces of sulphate of magnesium, and one drachm of mercury with chalk, given in ale gruel, and repeated in twenty-four hours' time, if purgation does not take place. One drachm of *mercury with chalk* may be given daily for a day or two. If any soreness of the mouth is thereby caused, or much discharge of saliva, this must be desisted from at once. The bowels should be kept open. The food should be nutritious, but supplied in small amount, and consist of carrots, turnips, mashes, oilcake, and so on. A little diluted nitro-hydrochloric acid (see the *Veterinary Pharmacopœia*) may be added to the water supplied, but only just sufficient to impart an agreeable acid taste. Careful nursing is requisite. Enemas may sometimes be advantageous.

In case the liver should be merely congested, there will be signs of dulness manifested after a meal, slight disorder of the breathing, a painful swelling on the right side, perhaps constipation, and yellowness of the mucous membranes. A gentle aperient, a change of diet, and a little exercise in the fresh air, if the animal is able to bear it, may be beneficial.

Hæmorrhage from the liver due to rupture may result from congestion or other changes in the organ. There is internal abdominal hæmorrhage, coupled with rapid sinking and sometimes with abdominal pain. If the capsule of the organ does not give way, the blood accumulates beneath it, and recovery may take place, if the animal be kept very quiet and strengthened with careful feeding and management. If the capsule bursts, there is no chance of recovery.

Considerable absorption of liver substance may take place as the result of parasitic invasion, or as a consequence of abnormal growths in it. Extensive changes may go on, especially such as are of a tubercular character, without much appreciable sign during life.

The livers of ruminants, and especially those of sheep, are liable to be infested with the peculiar trematode worms known as *flukes*. Sheep-rot is a well-known disease produced by these creatures. We have referred to this topic previously, and we must of necessity mention it in this place, although we have but little more to say of it than that it exists among oxen as well as among sheep. Indeed, our readers may remember that in our remarks on Parasitism we pointed out that flukes may even take up their abode in the livers of human beings. If the liver is markedly invaded by the *Fasciola hepatica*, there is manifestly a great loss of the secreting cells, the walls of the large and small bile-ducts being thickened.

SECTION VI.—DISEASES OF THE NERVOUS SYSTEM.

THE NERVOUS SYSTEM AND THE DISORDERS CONNECTED THEREWITH.

The above subject, which now in due course presents itself for consideration at our hands, furnishes at once one of the most

interesting and at the same time one of the most important topics of all those innumerable ones which demand discussion throughout the whole range of human inquiry. Those who can realise at all adequately the truth that the highest aspect from which life, both human and animal, can be regarded is to be gained by the study of the functions of the brain and of the nervous system as a whole, will readily grant that any knowledge acquired in regard to its working is of the very highest significance. Those investigators who wish to probe the inmost recesses of our complex existence must have recourse to the brain, the spinal cord, and the nerves both in health and in disease. It is true that a great deal is known, yet no less true that what is already known is simply nothing compared with that which still has to be patiently toiled after and deeply digged for.

Judging by the immense progress which has been made in the last half-century, the men of to-day, starting from the vantage-ground of the information at their disposal, may reasonably expect to make very many, and very great and marvellous discoveries. That human beings, with their limited intellectual powers, will ever be able to learn the real *rationale* of our existence upon this earth is probably impossible; but that we are capable of gaining an almost unlimited amount of knowledge, and therefore of power, over the various forces of nature and our own bodily functions is most certain, and most reassuring. Almost every day that passes brings some new facility into the sphere of human activities, brings some unlooked-for benefit, even though it be but a small one, to mankind. Often the advantage has an ugly look at first. It may even appear to be a curse rather than a blessing; but yet it is but a part of that grand and wondrous scheme which, though we cannot understand, is nevertheless steering straight to the point, the far-off goal in view.

Who could, a hundred years ago, have formed the least idea of the things which even children know and see and use to-day? Who can guess the startling possibilities of the future? We must not forget that we live in the age of progress, that we who are living now have been fortunately born at a particularly brilliant epoch, that we possess opportunities which our ancestors scarcely dreamt of, that we have many things in our favour helping us to advance farther and farther, both on old and

new lines, that we are endowed with powers of dealing with disease and of prolonging life which, if they could have conceived of them by way of guesswork, our ancestors, judging from their point of view, would perhaps have only slightly modified their ideas as to the possibility of finding out an "elixir of life" by which men could be made immortal upon the earth, and the philosopher's stone whereby all baser metals might be convertible into gold. Every now and then one is apt to forget the possibilities of this time and age, every now and then we require a mental stimulant to refresh us in our searchings after the truth. Everyday laborious work is all the better for a little of the spirit of aspiration, and it is a joyful thing for those who can infuse it into their toil to cultivate the power as well as the will to do so.

In his second Dissertation to Riolan, Harvey, as mentioned by Lewes, says:—

> Some weak and inexperienced persons vainly seek by dialectics and far-fetched arguments either to upset or establish things that are only to be founded on anatomical demonstration and believed on the evidence of the senses. He who truly desires to be informed of the question in hand must be held bound either to look for himself, or to take on trust the conclusions to which they who have looked have come.

Unfortunately, in the present state of science, the ideas which physiologists have as yet arrived at regarding the working of the nervous system are very unsatisfactory and incomplete. We have no space to say more here on this subject than that it is probable that some great discoverer, some earnest, patient, plodding, life-worker, as great or even greater than Harvey, is now needed to apply all the delicate methods of modern science to the elucidation of the wonderful part which the nervous system plays in all higher forms of life. At present it is quite impossible to clear up the methods by which the chemical and physical actions going on in nerve-cells and nerve fibres produce the complex and most peculiarly involved phenomena presented by all living beings which have reached any marked degree of development, and especially by human beings.

It may perhaps seem strange, but it is true, that physiologists know very little concerning the inner working of the brain and nervous system generally. Indeed, great advances must be

made before we can hope to comprehend these matters. Although the functions of the brain and nerve centres are probably the most interesting of all the subjects at present commanding the attention of scientific men, although it is of the greatest possible moment that we should understand them, still it cannot be said that much real progress has been made in the course of investigation.

Much has been, and is still being, done by way of investigation in reference to these matters, and in various directions much useful knowledge has been obtained. For instance, so nicely and so accurately are the centres which govern various movements now recognised, that the seat of lesion in the brain and cord can frequently be diagnosed with precision, and actual cures can be obtained by operations through the walls of the skull, and even through those of the spinal column. Such discoveries as these are truly wonderful, and they seem to pave the way towards even more important work still. There can be no doubt whatever that in the not far distant future still greater discoveries will be made, and further marvellous results attained by those who work on and on, patiently and surely, and with careful earnestness. Every branch of this wide subject should be most carefully worked at, and in this relation it is to be borne in mind that research among the normal and abnormal phenomena of the nervous system in lower animals is of the highest moment, in that the information thereby gained helps us to understand the mechanism in man himself.

True it is that in themselves the diseases of the nervous system of oxen are not of great import, even so far as the owner of stock is concerned. If we could not see a very much higher purpose to be saved than that which appeals to the pocket in this case, we should have very little reason indeed for insisting upon the value of the most careful study in this direction. In many cases of nervous disturbance in these animals, it is by far the best policy at once to order our patient to be summarily slaughtered. This is the simplest and the wisest plan, and it is certainly in nine cases out of ten the most economical. There are, however, exceptional instances where treatment may be called for. Yet, notwithstanding these cases, the derangements of the ox's nervous system are of such small importance that, were it not for the light which a study of them cannot but shed

upon the allied disorders of higher animals, it would scarcely seem worth while to treat of them at all.

It is incumbent upon us to remember that the nervous system of man is so complex a mechanism that even the smallest help in unravelling any of its mysteries is to be always eagerly sought after. The disorders of the nervous system to which we ourselves are liable are certainly among the most important of all the afflictions which beset mankind. Indeed, we have very good reasons for believing that, as our knowledge of pathology advances, we shall find that the nervous system plays a very potent part in regard to many diseases of which at present we can hardly lay claim to any understanding of the causation and progress. In lower animals the normal structure and the healthy functions of the nervous system are more simple, more readily intelligible, less complicated, less numerous, and less varied in their nature than is the case among ourselves. Hence, as might be expected, the diseases affecting this system are also more simple, and consequently more easily understood. Thus it happens that a knowledge of them does most certainly clear up some points of difficulty in regard to the disturbances of the equilibrium effected by the nerves and nerve-centres of higher animals.

We must not forget that human beings are endowed with the most highly developed nervous systems, and that the stress which is put upon the mental organization of man in these days is often enough, and still more frequently nearly enough, to upset the normal balance. Hence result many and various forms of madness and insanity, and misery and troubles and horrors of all kinds and degrees. There are many persons who are being daily and even hourly subjected to an immense strain, and there are many who show the results of this strain in one way or another, many who suffer severe mental pressure owing to the great amount of brain-work which they have set themselves to do. The fact is, that it seems to be one of the conditions of progress that there should be just a little more strain put upon the average members of a community than they can easily bear up against. By this means those persons who are provided with powers above the average are always getting a little higher, and still a little higher, until the maximum point is reached at which the strain is just sufficient to be, so to speak,

more than they can readily withstand. This gives a chance for those still better endowed, and so on and on, until we come to the very highest mental endowments.

Now all these disturbances of the nervous system to which we have alluded should be most carefully guarded against in every possibly way, and thus it happens that the diseases and disorders of the nervous system of lower animals attain a far higher significance than could possibly otherwise be attached to them.

It cannot be said that the nervous ailments of oxen are thoroughly understood. Those diseases which seem to be more intimately connected with the brain are those we now propose to discuss. We accordingly proceed to consider briefly:—Stomach-staggers, delirium, inflammation of the brain, epilepsy, and apoplexy. With regard to the presence of abscesses in the brain, all that need be said is that they are occasionally met with.

STOMACH-STAGGERS.

The disorder known among cattle-owners as "*stomach-staggers*" affords an extreme instance of the fact that the brain depends for its well-being on the healthy working of the stomach. When this organ is very full, the ox may become comatose, so much so, perhaps, as even to exhibit a tendency to fall down, especially if the head be elevated. The respirations are slow and deep, the pulse is slow and full, and the pupils of the eyes are dilated. In short, the symptoms may simulate those produced by narcotic poisons. The best treatment is to give at once a full cathartic dose, and also suitable stimulants. The disorder is not of much importance, it is not at all often met with, nor is it so extreme as is the malady of the same kind and name among horses.

DELIRIUM.

Delirium is not to be looked upon as a disease in itself, but as a symptom of different kinds of cerebral disturbance. It is met with in cases of inflammation of the brain, in certain blood-diseases, in acute indigestion, in impaction of the omasum, and as the result of some forms of poisoning, *e.g.* by lead. A delirious ox has, like other animals similarly afflicted, a peculiar wild look in the eyes, is excitable, or perhaps even quite frantic

and furious, struggles violently against restraint of any kind, champs, and gives out a frothy saliva from the mouth. It is highly dangerous to go near such an animal, and in many cases the best plan is to summarily shoot the sufferer before serious damage be done.

INFLAMMATION OF THE BRAIN.

Inflammation of the brain, or phrenitis, is not very commonly met with among cattle. The fact that acute indigestion, impaction of the omasum, or lead-poisoning, frequently give rise to delirium, which is always liable to be put down as a sign of phrenitis, makes this disease appear more general than it really is. However, our readers will recollect that in cases of actual inflammation of the brain there will be a manifestation of acute febrile symptoms. Either the membranes of the brain or the cerebral substance itself may be first attacked with inflammation. In the former case there is always good reason to fear the extension of this process towards the material of the brain.

When the coverings of the brain are inflamed, spasms, pain, and delirium are shown, the animal is violent, champs the teeth, scrapes, stamps, paws the ground, charges at objects which may be near, displays irregular movements, and more or less extreme convulsions. Sometimes these symptoms make their appearance at the first onset of the attack, and the loss of nerve power, the dull and stupid look, the more or less marked paralysis, the loss of sensation, resulting from the extension of inflammation to the brain itself come on later.

The disease is more particularly prevalent in hot countries and in hot seasons, especially if there has been a sudden change from cold to heat. The malady makes its appearance, especially among working oxen, and those which are plethoric. The disease, fortunately, is not so often met with as it used to be, owing doubtless to the facts that there is less over-driving, and that more care is taken of animals generally. A blow, producing concussion of the brain and perhaps fracture of the skull, or the eating of the refuse of alcohol distilleries, and perhaps even of ergotised grasses, or the growth of tumours in the brain, may all apparently bring on this disease.

SYMPTOMS.—At first there is acute congestion, and this is followed by severe inflammation. The animal appears sleepy or

foolish, and its pulse and respirations are few in number. Soon, febrile symptoms manifest themselves, the temperature being heightened, and the head and horns hot. The conjunctiva of the eyes is reddened with blood, the eyes themselves have a wild look, and if the brain itself is affected, they become more or less blind, and roll from side to side. The suffering animal may press the head against some object near, or may constantly try to rest the haunches on anything that is at hand. Violent paroxysms of delirium, in which the animal bellows and charges madly about, making it very unsafe for anyone to approach, alternate with periods of stupor. The poor creature trembles, undergoes more or less extreme convulsions, falls frequently, and at last paralysis, coma, and death close the scene. After death, if an examination be made, the membranes and the brain-substance are seen to be highly congested, the "puncta vasculosa" being unusually distinct. Sometimes the brain is softened, and there may be a large quantity of fluid in the arachnoid and sub-arachnoid spaces.

Treatment.—If a considerable amount of blood be abstracted at an early stage in the disease, there is no doubt that the congestion may be sometimes relieved. The application of cold water, too, to the head is sometimes beneficial, and a cathartic should be administered. For this purpose croton oil may be used, if the veterinarian shall think it advisable to do so, and it has also been recommended that sedative agents, such as hydrocyanic acid, should be administered subcutaneously. Although, however, in some cases the owner and the veterinary surgeon may both concur in thinking treatment advisable, there is no doubt that in most instances it will be thought best to order the animal to be shot, since it is often impossible to provide suitable nursing and treatment without endangering human life, and, even if the animal should be temporarily cured, there is a great liability of the disease re-appearing.

EPILEPSY, MEGRIMS, OR STAGGERS.

This affection, which is most prevalent among young and debilitated animals, may sometimes result from anæmia or certain other forms of blood disease. Cattle suffer from gastric vertigo not unlike epilepsy, or they may have epileptoid convulsions, it is said, as a result of long sea-voyages or rheumatism. Our

readers are familiar, probably, with the appearances presented by a person in an epileptic fit, and with the fact that in some of these cases a spiculum of bone has after death in some cases been found penetrating the brain. There may be other causes than this, such as abnormal growths at work, or the white matter of the brain may be hardened, while the grey portion is marbled or rosy, the membranes being adherent to the surfaces. As a fit comes on, the patient becomes dull, then suddenly loses brain power, falling and remaining recumbent in an unconscious condition for some time. In the case of a human being, the average duration of an epileptic fit may be a little more than four minutes, perhaps ; but it may be very severe—so severe, indeed, that death may be expected to end the dreadful convulsions. These may last half an hour or more. On the other hand, a fit may last about half a minute only. In any case, however, it is some little time before complete consciousness is regained, and it is, moreover, a gradual awakening to his full powers, and by no means a sudden one, which the sufferer experiences. For instance, a man may act with apparent sensibility soon after a fit, and some little time after he may have forgotten all that he did. Again, the patient would not remember what he did immediately before the fit began, until, perhaps, some hours afterwards.

These epileptic fits are very dangerous, inasmuch as, unless the sufferer takes the greatest care of himself or herself, great dangers may be encountered, such as, for instance, at a railway station or by the side of a precipitous chasm, or elsewhere. A patient may be suddenly seized by a fit while in a dangerous position, as, for instance, near the bank of a river or on the platform of a railway-station, just as the train is coming in. Fortunately, medicine, and especially the bromides of potassium, sodium, and ammonium, and other therapeutic agents, possess very great powers in controlling the epileptic seizures. Small doses of bromides can be taken for long periods of time with safety. Some patients seldom or never have a fit without a distinct warning of, perhaps, as much as from a quarter to half a minute, so that there is time to get away from serious danger. Often an epileptic, if possessed of a very determined mind, will tell those who are with him of the approach of a fit, though there is generally a great objection to do so. Sometimes they will

even stop the fit, as it is coming on, by an energetic and vigorous pinching of the legs or arms, or other part of the body. Napoleon I. is said to have suffered from epilepsy.

The feeling which precedes a fit is peculiar, and said by patients to be indescribable. It is not in itself unpleasant. It may sometimes be so slight as to be scarcely noticeable, and at others overpowering in its strength. The feeling is not at all painful. It seems to become stronger as the patient grows older, in some cases. There is no power of bringing on a fit by an effort of the will. Any kind of indigestion seems to bring on a fit. New bread, beef, bacon, or pork are to be avoided. Any cause which depresses the system is to be guarded against. The food should always be thoroughly well masticated, since a very small portion of solid, if swallowed, may bring on a fit. Over-eating and constipation are very hurtful in these cases. A friend informs us that he had fits from the age of seven to ten, none at all, so far as he knows, from ten to thirteen, but that he has had them at longer or shorter intervals ever since. Notwithstanding the immunity, however, during the time stated, he appears always to have had at times a slight sensation similar to the feeling above referred to.

During the seizure a patient lies senseless, with outstretched limbs, shivering, and more or less violently convulsed, as the case may be, while the muscles of respiration, and those of the eyes and jaws, also show convulsive movements. If the fit is severe, the veins of the neck may swell, and the patient may look as if on the verge of asphyxiation, gasping and foaming at the mouth. The face becomes purple, and the sufferer may present all the appearance of passing through the death-agony.

Personally, we do not recollect ever having seen an ox in an epileptic fit, but they are said to suffer similarly. An ox thus seized bellows, froths at the mouth, passes feces and urine involuntarily. Usually the convulsive movements soon cease, the animal rises, and soon appears healthy again. Many owners and veterinarians would advise slaughter in the case of an ox thus afflicted.

APOPLEXY.

Apoplexy is due to the blood-vessels of the brain being over-distended with blood and bursting, and to the pressure of the extravasated blood upon the walls, or to fracture of

the cranium, or to the bursting of an abscess. In the general way the disorder springs from plethora, and from over-driving and excitement in hot weather, when animals are in a plethoric condition.

The symptoms vary in accordance with the seat of the extravasated blood. As a rule they are sudden and marked. The animal first looks dull, reels, then falls suddenly, is completely unconscious, and unable to move or feel. The blood-vessels of the head and neck are seen to be very full. Indeed, the heart and the lungs are the only organs which exhibit signs of life. The pulse is small and thready, the breathing is slow, loud, and laboured, the surface of the body is covered with a cold sweat. The mouth is open, respiration being almost entirely carried on through it, and a frothy saliva is seen inside. The eyes are widely opened, they roll and stare, and the pupils are dilated; but though the pictures of external objects are formed upon the retina, the animal is, doubtless, not conscious of seeing them. Convulsive movements may show themselves, but, as a rule, the muscles are soft and flaccid. The animal becomes quiescent, and death may rapidly close the scene, owing to the transmission of the pressure to the medulla oblongata, and interference with the functions of this important nervous structure, which are so absolutely essential to life. In some cases, however, consciousness may return, and paroxysms of violent convulsions may alternate with short periods of quiescence, until coma and death ultimately ensue.

In regard to treatment, if the patient be seen in the first stage of dulness, free bleeding may be useful. A fairly strong cathartic dose should also be given. Other remedial measures may be tried, such as the application of a very strong liniment to the loins and spine; but in nine cases out of ten of real apoplexy in the ox the disease cannot be cured, and, indeed, is liable to recur. Hence slaughter is to be recommended.

HYDROCEPHALUS, OR WATER ON THE BRAIN.

This disorder is due to the accumulation of serous fluid either between or below the membranes which cover the brain. It occurs generally in the fœtus, causing great increase in the size of the head, and, therefore, severe difficulty in the act of parturition. The enormous head, when situated in the generative

passage, should be tapped with a trocar and long canula, or by means of a knife. If this be done, the cranium collapses, and the calf will then be expelled, dead. The disorder may also appear after birth, the cranial bones being thin and widespread. Many stellate little bones called Wormian bones are placed between them, so as to close up the large cavity so far as possible. The brain, of course, suffers greatly in these cases. Instances have been met with in which the base of the skull is the only part of it which is ossified.

The same parasites as appear in the brain of sheep, viz. the *Cœnuri cerebrales,* may occasionally be present in the brain of the ox. They are the immature forms of the *Tœnia cœnurus* which infests the dog. They affect various parts of the brain, the cerebral hemispheres being most frequently attacked. The egg of this tapeworm being swallowed, the embryo escapes, bores its way through the tissues, enters a blood-vessel, and finally, being carried in the course of the circulation to the brain, takes up its abode there, and increases in size by absorbing the substances around. When it is large, marked symptoms of brain-disease are exhibited. The animal may lean the head to one side, or may move round and round in the same direction as that on which the parasite is situated, or the pressure of any other kind is applied. The disorder is popularly known as "turnsick," is most often seen in young animals, and is more prevalent in some seasons than in others. Trephining may be tried.

Having thus discussed briefly certain diseases of the nervous system intimately connected with the brain itself, we now proceed to consider shortly those maladies which seem to be the result of disturbance of the functions of the spinal cord. Yet, while we are now writing down this statement, we cannot but feel how impossible it is to clearly mark off disorders of the brain from those of other parts of the nervous mechanism. Indeed, so impressed are we with the difficulties of classifying nervous diseases at all well that, before we pass on to the discussion of the proper subjects for to-day, we take this opportunity of pausing to see what Dr. Gowers teaches in regard to classification of nervous disorders in mankind.

"If we attempt," writes this well-known author, "to classify

the diseases according to either seat or nature, we are met at once by difficulties which prevent any complete arrangement." Many diseases affect more than one part of the nervous system, while the precise seat of some others is not known. A rough division is often made into two broad classes of "organic" and "functional" disease. In "organic diseases" there is a visible lesion. The "functional diseases" include (1) those which consist only in a disturbance of function, and (2) transient diseases which are not known to depend on organic changes. Nevertheless, there is also a large class of diseases in which no constant lesion has been discovered, but which are not transient.

The use of the microscope in pathology wonderfully extended the range of organic disease, and quite recently a still further extension of our powers of observing organic change resulted from the use of staining agents. It is, of course, the degree of alteration compared with the degree of our aided powers of vision which determines the question of visibility. Molecular changes in nutrition probably cause some diseases classed as functional. Hence "nutritional diseases" may be distinguished from those "functional diseases," properly so called, which consist merely in a derangement of function. Yet we must remember that, if prolonged, functional disturbance will lead to nutritional change. We may, then, distinguish four classes of nervous diseases.

1.—Organic disease, such as tumour, hemorrhage, softening. The morbid process always begins outside the nerve-elements.

2.—Structural disease, such as most forms of sclerosis. The morbid process may begin either in the nerve-elements or outside them.

3.—Nutritional disease, such as general paralysis of the insane, paralysis agitans, chorea. The nerve-elements are probably always primarily affected.

4.—Functional disease, such as reflex convulsions, and many forms of hysteria. Nerve-elements primarily affected.

This classification is not very useful, however, for descriptive purposes.

Myelitis, or softening of the spinal cord, is not of frequent occurrence in the case of this structure of the ox. Tetanus is a

disease in which the spinal cord is largely implicated. This serious malady we have already described, and all that we need say here in regard to it is that after death from tetanus the spinal cord and its membranes may be seen to be congested, and that there may be softening of the cord and accumulation of fluid between the membranes.

Paralysis is a nervous disorder which may be due to many different causes. An animal is said to be paralysed when it suffers from a loss of voluntary motor power in certain muscles. This want of motor power is generally accompanied by a loss of sensory power also. The connection between the two wants may be due to the contiguity of the sensory and motorial tracts in the case of the spinal cord and most of the nerves. Sometimes the whole of one side of the body may be affected, and in these cases the disorder is known under the name of hemiplegia. It appears to be most commonly the case that both hind limbs are affected in the ox, and when in this state the animal is said to be suffering from paraplegia. The disease may result from pressure on, or from disease of, some part of the nervous system, the brain, the spinal cord, or the nerves. The pressure may be due to a fracture, the paralysis coming on soon after a fall or some other injury. Though the loss of power may in certain cases come on suddenly, it does not usually do so, but may generally first be noticed in a staggering of the gait.

Paraplegia most frequently attacks animals advanced in age, and especially those that are taken or kept on low and damp pastures in severe weather. Cows which are pregnant may suffer from paraplegia, and recover after parturition. This may be caused by pressure on the posterior aorta, or on the iliac arteries which supply the hind limbs with blood. After death, tumours have in some cases of paralysis been found so situated as to press upon the nerves of the affected part. Again, the disorder may be occasioned by the ingestion of poisons, as in the case of the affection known as lead-palsy.

Treatment.—The animal should be made to lie comfortably, and be frequently turned, so as to avoid the production of sores. If the disease is very severe, or if we have any reason to suppose that there is a serious fracture, such as of the spine, or that the disease is occasioned by tumours, it is best to counsel slaughter. In regard to medicines, it may be said that iodide

of iron may be useful, and that the external application of the ointment of biniodide of mercury may also be of advantage. The food should be of a nutritious and laxative nature. It may be necessary to draw away the urine frequently with a catheter. The affected parts should be well rubbed with the hand and kept warm, if required, by the aid of clothing.

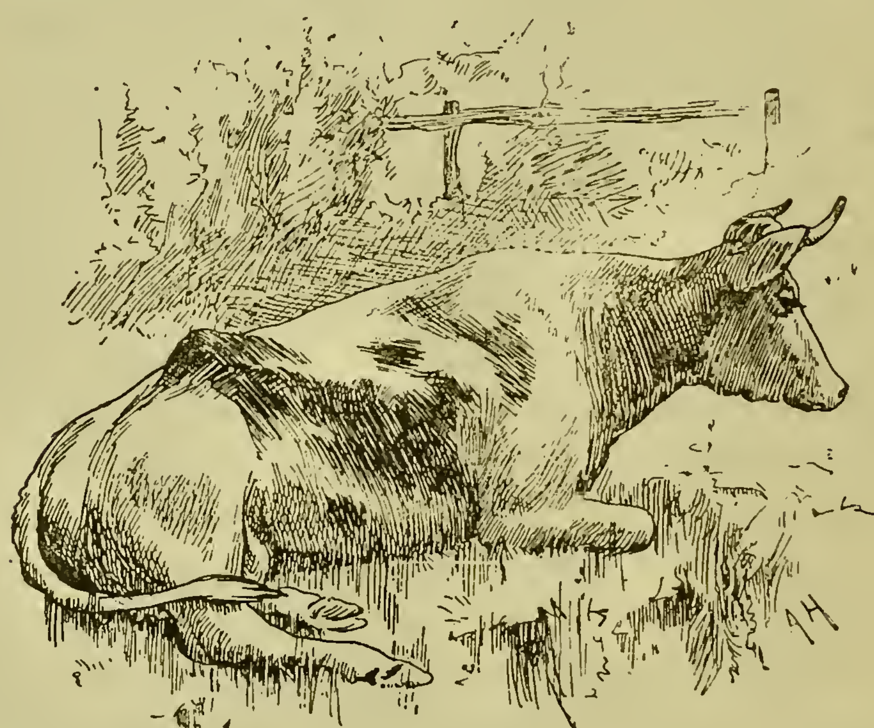


FIG. 73.—NERVOUS DEBILITY IN COWS AT THE TIME OF PARTURITION.

The cow, as delineated in the above picture, is the subject of nervous debility, occurring about the time of parturition. This is a malady due to the functional disorder alone, and it is not as a rule followed by death. Our artist has faithfully represented the characteristic appearances of this disease. The observer will readily note, from the attitude of the cow, that she suffers from general weakness and loss of nerve-power. She is represented as lying in a recumbent posture in the field, but she has now no inclination for browsing on the grass beside her, nor is she represented as chewing the cud—a usual sign of undisturbed health in the case of ruminating animals. She has no delight to move leisurely in the luxuriant pasture, nor does the sweet woodland scenery attract her gaze ; but she must needs lie down powerless, the vigorous activity of health having left her—let us hope only for a short time, and that her health will be restored after men have taken her with care and gentleness to a dry shed or ox-stall, nicely bedded down with clean new straw, and then keeping her warm, attending to every want, and administering such remedies as may be found advisable.

The next disease to which we come is that known by the name of *Adynamia nervosa generalis* (Armatage). This is a kind of nervous debility which affects cows during the later period of pregnancy. The sufferer is unable to rise, is cold on the surface of the body, has a weak pulse, and the bowels are usually constipated. Possibly the malady may be engendered by pressure on the posterior aorta, though it may be difficult to

see why obstruction to the circulation in the hind limbs should cause nervous adynamia of the whole system. The affection often persists after parturition has taken place; but this may be explained on the idea that the disordered state of the blood-supply must take some time to be set quite right again. The disease may be owing to the fœtus requiring a great deal of nutritive material from the mother.

TREATMENT.—The bowels must be kept open by means of the administration of enemas, the surface of the body must be kept warm, and the strength of the patient must be sustained, so far as is possible. It is also rather beneficial that stimulating applications should be rubbed along the back.

A disease to which the name of *Cerebro-spinal Meningitis* has been given may come on in the cow several days after calving, the patient being free from coma, and not assuming the recumbent posture at all. The bowels may be but slightly deranged, or the sufferer may be troubled with a fetid diarrhœa. The secretion of milk, the excretion of urine, voluntary muscular power, and sensation are not interfered with. The patient may die of apoplexy about four and a half days after the commencement of the malady, or may gradually recover. If the nerve-structures are examined after death, effusion and extravasation of serum and blood are found on the meninges and spinal cord.

Stringhalt is a disease well known among horsemen as affecting horses. A similar condition has been described as attacking oxen, and in one instance it is recorded that a number of animals were afflicted with this disorder apparently as a result of giving them burnt ale with their food.

Milk fever, or parturient apoplexy, is a disease which may occur in the cow generally within three days after calving, though it is said to come on before parturition, and even several weeks after that event. The fever most frequently manifests itself after an easy delivery, in warm weather, in plethoric animals, in good milkers, and in old animals seldom before the third calf, and most generally after the fifth. In those cows which have once suffered from this serious disorder it is very likely to come on again.

A short time after delivery has taken place, the cow shows a restlessness, raises first one hind-foot and then the other,

breathes a little more quickly, does not like movement, and, if caused to move, staggers in her gait, loses appetite, ceases to chew the cud and to give milk, and has a staring look in the eyes. The hind-limbs give way about twenty hours after the onset of the disease, the animal falls to the ground, and remains in the recumbent posture. The eyes are now blood-shot, and they protrude, and are insensible to the touch. There is, in fact, a loss of sensation all over the body, and, moreover, a loss of power of voluntary motion. The pulse is full, soft, and slow, but as the disease progresses it becomes faster and smaller, and finally imperceptible. The breathing, too, is slow, and after a time stertorous. The mucous membranes are purple in colour, and the head and horns are hot.

The animal may probably be delirious, and dash its head about with excessive violence, or it may lapse into a state of coma, and lie with the head flexed round on the shoulder. The muscles of the eyelids twitch convulsively, the udder retains its soft condition, or may perhaps become hard and small. The animal cannot swallow, the bowels do not act, the urine remains in the bladder. The animal becomes blown-up with wind, and becoming more and more comatose, at length dies. In some cases, especially if the animal is well treated, recovery may be hoped for. There is, however, danger of a relapse, and in order to obviate this risk, the patient should be most carefully attended to, and occasionally turned so that it does not lie for a long time upon the same side.

After death the veins may be seen to be distended with black blood, there are petechiæ on various serous membranes, the brain and spinal cord show congestion and extravasation of blood. It is difficult to say what is the cause of the disease. It may be due to encephalic anæmia. On the other hand the coma, delirium, and convulsions, are probably due to the congestion of the brain and spinal cord. The removal of the offspring from the mother seems to bring on milk-fever, and hence it looks as if the presence in the blood of matters which ought to have been expelled from it by the medium of the milk has a great deal to do with the disease.

In regard to treatment, it may first be said that it is well to allow a cow to take a little gentle exercise during the few days before delivery is expected to take place, to avoid plethora, and

perhaps to give a gentle cathartic draught. If called to a cow suffering from the early stages of the disease, the veterinarian will probably abstract blood, and he will probably administer a full cathartic dose, at whatever stage he finds his patient. A combination of sulphate of magnesium and solution of aloes forms a useful cathartic mixture. The most assiduous care is requisite throughout the course of the malady. The suffering animal should be supported by bundles of straw, kept warm by being covered with rugs, the udder should be regularly milked, and the body should be well rubbed. Ice-bags or cold water may be suitably applied to the forehead, and diffusible stimulants should be somewhat freely administered. A strong stimulating liniment should be rubbed along the spine. Enemas may be frequently given, and the urine should be drawn off by the aid of a catheter from time to time.

Medicines should be given by means of the stomach-pump, whereby the tympany will also be relieved. Gruel diet, or at any rate easily digestible laxative food, should be supplied. After recovery the animal may still suffer from paraplegia, and if this is not amenable to the action of tonics, and the application of absorbent agents and blisters over the spine, the animal should be slaughtered and used for food, if the flesh is suitable for this purpose.

Our readers will understand that milk-fever is to be distinguished from ordinary fever occurring after parturition, and called parturient fever ; also from septic peritonitis, adynamia, and simple metritis. *Puerperal mania* may now and again occur a few days after parturition, being probably due to exposure, dyspepsia, and to removal of the calf from the cow. The animal is very excitable, champs with the jaws, gnaws at objects which may be near, and especially its own fore-legs. The careful administration of opiates is to be recommended in these cases.

SECTION VII.—THE URINARY SYSTEM AND THE DISORDERS CONNECTED THEREWITH.

The various derangements to which the kidneys of animals are liable are by no means the least important of the innumerable maladies which may afflict them. Especially is it the case that, in so far as our subject bears upon the preservation of the health

of human beings, it is indeed one of the most intense interest and greatest import. Very safely may we say that there are many persons ostensibly enjoying good, or at least fair, health, who would do very wisely to turn their attention to these too often neglected and ill-used portions of their bodily frames. We should always bear in mind that the kidneys are organs by whose activity some of those useless and noxious, or rather poisonous, products resulting from the wear and tear of the numerous vital processes involved in bodily and mental work are separated from the blood, and rendered capable of being readily eliminated from the system through the channels afforded by the ureters, the urinary bladder, and the urethra. In short, the kidneys are endowed with a most important function in the animal economy.

The conditions of this nineteenth-century civilisation, leading, as they do, more and more markedly, to the concentration of immense aggregations of people in the towns and cities of the world, to a large extent—inevitably, as it seems—also bring about an abstention from the active side of life on the part of those persons whose sphere is the counting-house or the printer's work-room, the banker's, the merchant's, or the lawyer's office, the pulpit, the school-room, the doctor's consulting-room, the statesman's sanctum, and, perhaps still more than any of these, the writer's or the editor's arm-chair. It is manifest that, as a nation advances, the social division of labour becomes more and more minute, and it is sufficiently clear that it must be much more extreme in the future even than it is now. The tendency of the tide of progress is towards the channels of specialism. Great danger is to be feared on this account, and one of the gravest risks of all is that many of those who live by brain work and sedentary work of any kind will become more and more rigidly compelled to ignore the great law of nature that man should live literally *by the sweat of his brow*, and not by that of his brain.

Certainly, those who live by tilling the soil or by other forms of physical toil, provided that they are fairly strong, pursue a more healthy mode of life. In them the kidneys, the liver, and the other organs of the body have more stimulus to perform their due and proper functions suitably. So far, then, from being worse off than many of their so-called betters, the horny-handed

sons of labour must in many cases be supposed to have the best of it, unless, indeed, the mental workers with whom we are now contrasting them, take care to preserve their health by wise attention to the necessity of regular exercise and the laws of hygiene. If they do this, *i.e.* if they preserve the healthy mind without detriment to the healthy body, then there can be no doubt that those who work with their brains live the best and highest lives. Yet there is nothing more difficult than to combine judiciously the two orders of work. Those who toil in the mental spheres—and whether it be of high or low degree matters but little, provided it be sedentary in character—those who are confined to the stool and the desk, are very apt to lose in large measure both the desire and the capacity for taking any prominent part in the more active habits of life. Herein lies great danger.

If there is any truth which requires more reiteration than other truths in these days, it is that on no account should the active side of life be lost sight of. Indeed, it will almost invariably be found upon inquiry that those men and women who excel even in mental pursuits do not forget the absolute necessity of exercise for those who would preserve a good state of health both of body and mind. There are many reasons why physical work is essential to the preservation of health. One of these is that the skin is thereby called into activity as an excreting organ; and that if the skin does not act well, then a great deal more work is thrown upon the kidneys than they can properly perform.

Among oxen, as well as among ourselves, the class of urinary diseases is one of importance. Some may, perhaps, know that in its first condition in the undeveloped human fœtus each kidney is composed of separate lobules. At a later stage, these lobules are united together to form the smooth-surfaced kidney of the adult. Now, when we look upon the exterior of the kidney of an ox and of certain other animals the organ is seen to retain this lobulated condition—transitory in the human being—throughout life. The kidneys of the ox, in like manner with the urinary bladder, are large. The urine is light yellow in colour, and, like that of other herbivorous animals, it has an alkaline reaction, which may be easily shown by the fact that reddened litmus paper, when dipped in this fluid, is turned

blue. The urine of man, on the other hand, like that of carnivorous animals, is normally acid in reaction, being, however, sometimes neutral or almost neutral. The specific gravity of the urine of the ox is about 1036. As compared with that of the horse, the urine of the ox contains more water, more hippurate of potassium, and chloride of sodium, and much less urea. There is scarcely any carbonate of calcium in it.

The simplest disorder of the urinary apparatus in oxen goes by the name of incontinence of urine. The constant dripping may be due to relaxation of the urethral canal at its commencement, to irritability of the bladder, or perhaps to an acrid state of the urine, as occurs in the disease known as hæmaturia. Some veterinarians might inject demulcents into the bladder. Sedative applications may be placed on the hypogastrium. Usually the disorder is not treated, being of scarcely sufficient importance.

DIABETES INSIPIDUS, OR DIABETES SIMPLEX, OR POLYURIA, OR HYDRURIA.

This derangement, which under certain conditions is very common among horses, is, on the contrary, so rare in the ox that we do not recollect ever having been called to a case of it. It is manifested by profuse urination, and, as might be expected, it may be brought on by excessive drinking of fluids. It may, too, be occasioned by the presence of some diuretic substance in the blood. It may also probably be caused by a disordered condition of the vaso-motor centres, due perhaps to defective assimilation, whereby a dilatation of the renal vessels is produced. The urine, being discharged in great quantity, has a low specific gravity, and a pale colour. The animal loses appetite, is very thirsty, and may be feverish. The bowels are usually more or less constipated, the mucous membranes pale, and the sufferer may become very feeble and bloodless.

Diabetes may occur also as a crisis in fevers. The urine may then have a higher specific gravity owing to its containing a large excess of urea; but, when thus occurring as a crisis, it is not accompanied by unfavourable symptoms. On the contrary, it rapidly subsides, and is of favourable omen.

The food-supply should be changed, and the patient should be allowed good nutritious diet, and a fair quantity of water. A

laxative dose is to be recommended. The tincture of iodine may be prescribed in suitable doses, or iodide of potassium may be given in the drinking water. Vegetable tonics may also be beneficial, especially in the later stages.

SUPPRESSION OF URINE.

The urine may be completely suppressed, though only very rarely, owing to acute inflammation of the kidneys. It is frequently partly suppressed in acute febrile diseases.

In oxen suffering from certain febrile states there may be a deficient secretion of urine, and what is passed will then probably be of high specific gravity. It is also sometimes the case that this condition may be seen in draught oxen in dry countries, or among cattle kept on dry pastures in hot, dry weather. According to Mr. Parkes, a working ox, fed on dry food, should be supplied with about seven gallons of water daily, and it is clear that in parched-up fields, where the sources of water supply are often dried up, oxen may often suffer from an insufficiency of fluid.

ALBUMINURIA.

Albuminuria is a symptom of a large number of different abnormal conditions. Although some persons say that albuminuria may occur independently of structural change, as a rule it is due to congestion or inflammation of some part of the urinary tract. When it is due to an affection of the kidney, it is usually the result of cold, injuries, errors of diet, and, speaking generally, its pathology consists in congestion or in inflammation.

Albuminuria may also be temporarily induced by cold, or injuries acting upon the spinal cord, by errors of diet, such as, for instance, those errors of diet which produce at one time anæmia and at others plethora, such as sudden changes from poor to very rich food, or from very rich to very poor aliment.

Symptoms.—Albuminuria is itself but a symptom of a great many different affections, and hence the symptoms which are associated with it vary considerably according to the disease. Albumen is proved to be present by the usual chemical tests, and the microscope reveals spherical, epithelial cells and granular matter.

Treatment.—The patient should be put into a comfortable

stall, protected from cold, and supplied with good and easily-digestible food. The application of mustard to the loins is beneficial in some cases. It is generally advisable to administer a cathartic drench, and to repeat it, if necessary, in two days' time, and in certain cases to give enemas. Cupping over the loins has been adopted with success, when there is acute inflammation of the kidneys. An infusion of digitalis may be tried in suitable doses, but only according to the prescription of a scientist, or by his directions.

HÆMOGLOBINURIA IN CATTLE.

The following is taken from the *Lancet*, of Dec. 8th, 1888 :—

Professor Babes has found that cattle in the low marshy ground on the banks of the Lower Danube are exceedingly subject to albuminuria, which is often confounded with rinderpest. It has fortunately been much less common during the last few years, owing to the stringent police sanitary regulations which have been enforced. Still, from 30,000 to 50,000 head of cattle are even now annually destroyed by it, the bulls being by far the most numerous victims, heifers and cows appearing to have less disposition to contract the disease. A special coccus has been found which refracts light powerfully. It has a diameter of about half a millimetre, and presents very much the characters of the gonococci. It can be cultivated in agar-agar at the temperature of the body; but Professor Babes has not yet succeeded in infecting animals by its means.

CONGESTION OF THE KIDNEYS.

This results from interference with the heart's action or the pulmonary circulation. It derives importance as signifying these conditions, and hence it is necessary to give attention to it.

NEPHRITIS, OR INFLAMMATION OF THE KIDNEYS.

Nephritis, or inflammation of the kidneys, is fortunately only rarely met with among cattle. The disease, moreover, only seems to afflict working oxen. In the case of the horse, the disease, when it breaks out, is usually found to result from the excessive administration of diuretic agents of an irritating kind, given unwisely with the view of improving the condition of the animal. Nephritis may arise in any animal as a consequence of injury, and of an extension of inflammation from other structures near.

SYMPTOMS.—If both kidneys be affected, the urine may be almost entirely suppressed, although it is only rarely completely suppressed. Febrile signs are exhibited, the appetite is lost,

the skin has a staring character, and there may be acute pain manifested, if the loins be pressed. If the suppression of urine be continued, uræmia may set in, and the animal may become comatose and convulsed, and death may ensue. The urine has a very high specific gravity, and contains albumen and blood-cells and casts of the renal tubules.

However, nephritis may be limited to one kidney, and, if so, it is generally due to the presence of a calculus or of calculi in the pelvis of the kidney. If this be the case, the urine is thick and small in amount, quickly becomes ammoniacal, and contains much albumen, large quantities of pus, with perhaps blood. Moreover, small amounts of urine are passed at frequent intervals and with evident pain, and the animal strains and keeps on trying to urinate, although on catheterisation the bladder is found to be empty. The patient shows signs of pain, stands with arched back, or, if made to move, progresses stiffly and with a straddling gait. If the loins be pressed, acute pain is manifested. Uræmia sets in, together with urinous sweats, and after death one kidney, or both, may be found to be disorganized, reddened, and enlarged—*i.e.* in a state of suppurative inflammation.

ACUTE INFLAMMATION OF THE KIDNEYS IN LAMBS.

All good work in reference to the diseases of the sheep is most welcome, and hence we now take the liberty of abstracting the following account of acute nephritis in lambs from a paper by Mr. W. Roger Williams, F.R.C.S., read before the Pathological Society of London on April 6th, 1886. It seems that the farmers around Dunchurch, near Rugby, having had serious losses among the lambs in the spring, asked Dr. Unwin, of that place, about this disease, and he wrote to ask Mr. Williams to investigate the malady. The latter gentleman received the bodies of two lambs, one of which had died of the disease, the other having been killed whilst suffering from it when nearly three weeks old.

When the first body was opened, the bladder was found to be moderately distended with turbid whitish urine, which, after standing, deposited a great deal of albuminous sediment. This was collected and examined, and found to contain albumen.

The urine itself was acid in reaction. No casts, no crystals, no pus, and no blood, could be detected by the aid of the microscope; but the kidneys, when removed and examined, presented well-marked signs of disease. The capsules separated very readily, leaving exposed a yellowish surface mottled with congested stellate veins. The cortex, when cut into, was seen to be swollen, pale yellow in colour, and exceedingly soft. Moreover, the pyramids were firm and of a deep red colour.

Microscopical examination of the kidneys revealed the fact that the disease was acute tubal nephritis. All the uriniferous tubules of the cortex were greatly distended and choked up by the swollen and degenerated epithelium cells. In the case of the greater number of the sections, the outlines of the cells themselves could not be distinctly seen, though the nuclei could often be made out. The cells were in such an advanced stage of granular degeneration that for the most part they did not stain with logwood, although the Malpighian vessels and adjacent structures did take this stain. Indeed, the Malpighian vascular tufts were very prominent, while their linings of epithelial cells were in an advanced stage of granular degeneration, and, like the cells of the uriniferous tubules, they were not stained by the logwood, and could scarcely be distinguished. All the tubules of the cortex of both kidneys were affected, but the interstitial tissues were quite normal in appearance, and the epithelium of the tubules of the pyramids was but slightly affected.

The kidneys of the other lamb presented quite similar, but not such decided changes. The skeleton, the brain, the spinal cord (which was microscopically examined), and likewise the navel, were all free from signs of disease.

The following were the symptoms as gleaned partly from Dr. Unwin, and partly from Mr. Goodacre, a farmer, who lost scores of lambs. As soon as born, the lambs looked weak, and the disease itself generally appeared soon after birth, or some lambs were even born almost lifeless and died soon afterwards. Difficulty in walking is one of the first symptoms, the lambs reel about, and subsequently entirely lose the power of walking, and even that of standing, and the weakness increases very rapidly, and at length the animals fall down and remain lying on one side. The loss of power is seen in all the limbs equally. The lambs

suck with great avidity when the teat or bottle is brought to them, and in this way they may be kept alive for two or three weeks; but if they are not supplied with milk from a bottle or otherwise, they soon die, and when afflicted with this disease they always die in the long run, generally as a direct consequence of the disease, but sometimes also as a result of falling into some ditch, pit, or pond.

Dr. Unwin, who had a lamb suffering in this way under observation in his paddock for nearly a fortnight, observed that the little animal was capable of eating and drinking when food was brought to it as freely as a healthy lamb, that it was quite conscious, and had no cough or difficulty in breathing, and that its excretions looked normal. Yet it could not stand, but would struggle and kick violently as it lay on its side. There was apparently no loss of sensation, for the prick of a pin applied to each of its extremities could be felt. If placed on its feet, the little creature immediately dropped on its side, and tremors and choreic movements would come on and continue for some time. Grazing, while the animal lay in this recumbent position, was out of the question.

The malady may, it is said, sometimes terminate in the joints becoming enlarged owing to the accumulation of pus in them, and pus may also appear along the course of the spine. This, however, may be really pyæmia occurring in connection with suppuration of the remains of the umbilical cord. The disease has been known to break out on some farms for many years, being more prevalent in some years than in others. It was rather general in and near Dunchurch, and it seemed to affect chiefly the lambs of ewes which had recently been imported from Scotland. In the spring of the year 1884 some farmers lost two or three lambs, whilst others lost dozens.

It seems that the disease for the most part occurs in the offspring of ewes of the black-faced horned Scotch and Cheviot breeds recently brought from Scotland, by home-bred rams, although at times an ewe of the country may also bring forth lambs affected with the disease. One home-bred ram was allowed to run with 50 or 60 ewes, but the lambs were weakly, and frightful losses occurred from sheep-rot. In order to obviate this liability, the above-mentioned foreign ewes were imported, and about the same number of ewes were run with each ram as

before. Mr. Goodacre, however, tried the effect of running one ram with only ten ewes, and the result was that many of the ewes had two lambs, and in all cases the lambs appeared to be unusually strong. Ewes are brought from Scotland, and about three weeks afterwards those which are healthy are put with a ram.

It cannot be said that there is any difference in regard to the liability to this disease between the two kinds of ewes, viz. those which are imported and those which are home-bred ; but great care should be taken to ensure that those from Scotland, coming as they do from a hilly country, where in a half-wild state they subsist on meagre diet, should be quite strong and healthy before they are used for the purpose of breeding. The district in which the disease broke out was a gently undulating grazing country, with plenty of large trees, high hedge-rows, and coarse rank grass. The soil was cold, heavy, wet, and clayey, and at the time of lambing the east winds were very cold and severe.

Mr. Williams considers the disease to be due to the following two causes :—In the first place, there can be no doubt that the ewes must be injured by sudden exposure to rigorous conditions without previously having been gradually acclimatised, and, in consequence, they may give birth to lambs either suffering or on the point of suffering from disease. Darwin has shown the great susceptibility of the reproductive system, and especially of that of female animals, to changed and abnormal conditions in the environment. Even monstrosities may be artifically produced in the offspring by exposing parents to certain extraordinary conditions of life without any obvious abnormalities being produced in the parents themselves. Possibly there may be only disturbed action of the kidneys in the mothers, but doubtless this may be transmitted to the lambs in the exaggerated form of actual and acute disease.

In the second place Mr. Williams thinks—and no doubt he is right in so thinking—that one of the causes of the disease is the fact of one ram being put with so many ewes. It appears to be the fact that more than a single spermatozoon is, in the case of the higher plants and animals, requisite to properly fertilise the ovum. Newport has shown that when only a small number of spermatozoa are applied to the ova of batrachians they are only partially impregnated, and the embryo is never developed.

Again, Naudin's experiments on mirabilis are especially interesting, for when he fertilised a flower with three grains of pollen he succeeded in obtaining perfect seed ; but when he used only two grains, and finally a single grain, in a series of seventeen experiments, he only succeeded in getting two seeds formed, and the plants produced from these seeds never reached the ordinary dimensions, and their flowers were remarkably small.

Our readers will, then, observe that it is unwise to bring ewes from the hills of Scotland, or from any other far-distant place, just before the time of mating. Every breeding animal should be acclimatised before being impregnated ; and, moreover, it is a very grievous mistake to run too many ewes with one ram under any circumstances, and especially in the case of abrupt crosses, as, for instance, betwixt Scotch and English breeds.

URÆMIA.

Uræmia is a most serious disease, occasioned by the more or less complete cessation of the excretion of the waste products of the body which the kidneys ought to separate from the blood. It supervenes in cases of inflammation of the kidneys, especially when both those organs are involved. When these excretory organs are out of working order, the function ordinarily performed by them is in a large measure thrown upon the skin, bowels, and liver ; but these structures cannot do the necessary work, and indeed the renal mischief is frequently due to their functions being checked, and the result is the condition known as uræmia, in which the blood contains an excess of waste products. The blood always, even in healthy animals, contains some urea.

HÆMATURIA, OR BLOOD IN THE URINE.

This disorder may be due to injuries, such as may be produced by straining, falling into ditches, or by oxen leaping on one another ; also to acute congestion or ulceration of the kidneys or urinary passages, administration of too much of a diuretic drug or drugs, the eating of acrid plants, some forms of general blood disease, the presence of calculi, or, according to Mr. John Brett, M.R.C.V.S., as a sequel to tuberculosis of the kidney.* This writer records that he was called to a case

* Vide *The Veterinarian* for October 1887.

of so-called "red water," which had been some weeks previously under apparently successful treatment; but during the last few days before he was summoned to attend the cow she had become rapidly worse. The animal had been fed on large quantities of rank, coarse, innutritious grass grown on poor sandy land, irrigated with the refuse liquor from bone and glue works. The cow was found to be in the recumbent posture, occasionally taking a mouthful of grass, and then turning her head round to the left side and groaning. The pulse was feeble, the respirations were accelerated, and the temperature was 102° F.

Two days afterwards the cow had lost flesh, the pulse was scarcely perceptible, the temperature had fallen to 101° F., and the pain was not so acute as before. The urine was dark red in colour, had a fetid odour, and its specific gravity at 60° F. was 1,015. The reaction was alkaline, there were no blood clots, but many blood cells and tube casts. Now the average weight of an ox's kidney is said to be about $1\frac{1}{2}$ lb., but the right kidney in this case weighed as much as 5 lb. 12 oz. (avoirdupois). It was soft, flabby, and high-coloured, several of the lobules being almost black. The capsules of the lobules were thickened, and in certain places corrugated and detached. Tuberculous nodules, indicating different stages of the disease, were found in every lobule. In several lobules the whole of the inner part or medulla was gone.

Symptoms.—There is in this disorder a frequent discharge of small quantities of urine, containing, as a rule, coagulated blood. Pressure on the loins may bring on pain, the animal stands with the back arched, moves with a staggering gait, and may manifest febrile symptoms.

Treatment.—If the disease is the result of an injury, attempts must be made to heal it. Cold enemas and the application of cold water to the loins may be recommended. Demulcent drinks and small doses of oil are beneficial, the diet should be laxative, and such hæmostatic agents as diluted sulphuric acid and the acetate of lead may be administered in suitable doses.

RETENTION OF URINE.

Retention of urine may be owing to obstruction on the one hand, or to a want of expulsive power on the other. For

example a loss of strength in the bladder itself may be due to nervous lesions, as in apoplectic cases. As a rule when the retention is due to nervous disorder, there is incontinence of urine, the overfull bladder dribbling out its contents. Again, the retention may be due to spasm of the neck of the bladder, which may or may not be coupled with inflammation. Retention may also be, and usually is, due to a blocking up of the urethra by calculi or other obstructions, or to the presence of hardened feces in the rectum. The bladder may even burst, without the manifestation of much suffering on the part of the animal. As a rule, however, the ox is very irritable when suffering from retention of urine, lashes the tail, lifts up the hind limbs and places them on the ground again, perhaps rises and lies down again frequently, tries to pass water, and looks anxiously round at the flank. The only measure which can be of any advantage is to pass the catheter.

The name of dysuria is given to the painful expulsion of urine, and that of strangury to the painful passage of that fluid drop by drop as occurs in spasm or inflammation of the neck of the bladder.

A pervious condition of the urachus in calves may lead to a constant dribbling of urine through the umbilicus. A ligature around the umbilicus or sutures may be tried. The condition may disappear. It is most frequent in animals that have been born prematurely.

PARASITES AND CONCRETIONS.

Parasites have been found in the kidneys of the ox, but not so often as in those of the horse.

Stones or calculi may sometimes be present in the kidney. There may be several of them. They are irregular, dense, and laminated, and they vary a great deal in size, and in the effects which they produce. They may cause chronic suppurative nephritis. The best course in these cases is usually to be found in fattening the animal and then slaughtering. If, however, it is preferred to treat the patient, stimulants may be tried, unless there is much pain requiring to be assuaged by opiates. The medicine indicated will vary with the particular circumstances of each special case. Sometimes a small stone may pass from the kidney into the duct leading from that organ to the bladder,

and known as the ureter. The calculus may become lodged therein, and such passage may cause severe pain. The suffering animal strains, stamps the feet, lashes the tail, looks round at the side as if in wonder whence comes the torture. Relief may be obtained by the judicious administration of opiates.

Again, stones may be formed in the bladder. This is more frequently an affection of male animals. It is often due to the presence of a large quantity of certain salts in the food or water —for instance, to a considerable amount of phosphates in oilcake or turnips. In all cases of calculus the dietary should be looked to, and a plentiful supply of water allowed. The patient moves in a straddling manner, and is stiff in the region of the loins. With regard to the flow of urine in these cases, it may often be free at first, and then suddenly stop short, apparently because the stone falls into the neck of the bladder, thus obstructing the channel. Should the stone pass out of the bladder, and become fixed in the urethra, then obstinate retention of urine is the result, and so great may be the pressure of the fluid from above that actual rupture of the urethra may occur. It is not infrequent in cases of stone in the bladder to find blood in the urine.

Of the three operations which might be resorted to, viz. artificial dilatation of the urethra by little inflated bladders or otherwise, crushing of the stone by means of instruments made for that purpose, or cutting for the stone, not one seems to be usually very advisable in the case of the ox; but advice should be sought. In the case of female animals, perhaps, more success may be hoped for. Should the calculus be present in the urethra, as is not very uncommon in the ox, a longitudinal or oblique incision may be made along that canal over the stone, that is in case it can be found, and provided that its position renders this step advisable. The patient must not be cast, as the violence of the fall may bring on rupture.

Finally, præputial calculus may be removed by cutting away the hairs at the præputial orifice.

Now, the first subject in this connection in regard to *sheep* is that of urethral calculi. These are frequently found to be present in sheep kept in certain districts, as, for instance, on the Cotswold Hills. The calculi are doubtless for the most part formed in the urinary bladder, and then pass along the urethral canal.

Sheep afflicted with the presence of these stones in the urethra are dull and restless, pant and grunt, abstain from taking their food, attempt to urinate, and rise up and lie down alternately. These symptoms, and especially the abdominal pain, increase in point of severity, marked febrile signs manifest themselves, and, unless relief is obtained, the suffering animals at length die. In some cases, however, recovery may take place spontaneously, owing to the escape of the calculus through the urethral canal at a place above the vermiform process. If this occurs in rams, they are thereby rendered useless for breeding purposes. If, as is usually the case, this does not happen, it is advisable for the surgeon to cut with care down on to the calculus, and then to remove it.

Occasionally sheep may discharge the material which in the general way composes calculi, and in these cases the deposit may be detected in the urine, and the bladder is irritated by the presence of the calculus-forming sediment. Owing to this deposition of phosphates, strangury may occur in rams and wethers. The cause is no doubt the consumption of food which is rich in phosphates. Moreover, preputial calculi may be present on the wool around the prepuce of sheep. In these cases the triple phosphates, being deposited from the urine, block up the urethra, and escape of the obstructing material is prevented by the presence of the vermiform appendage. Indeed, rupture of the bladder may often occur, and after death has resulted, general congestion is observed, and an odour like that of urine pervades the body.

The only effectual method of doing any real good is either to cut off the vermiform appendage in order to allow of the escape of the deposit, or to cut into the urethral canal itself above the place where the obstruction exists. In very mild cases aperients and mineral acids may be highly beneficial.

CYSTITIS, OR INFLAMMATION OF THE BLADDER.

Cystitis, or inflammation of the bladder, is very rare in the ox. It may, however, arise from the use of cantharides, or may result from injuries. The whole bladder, or the neck only, may be implicated. There is retention of urine, which, when evacuated, is found to contain albumen. Anxious looking at the flank with general anxious expression indicate pain, and acute febrile symptoms come on. The urine should be

drawn off with a catheter, and then warm sedative solutions, such as infusion of poppies, may be injected into the bladder. Some regard the introducing of a catheter and of injections as likely to make the inflammation worse. Discretion must be used, and the treatment necessary will vary according as the inflammation is acute or chronic, and as the animal be a male or a female. Warm or hot water should be applied to the abdomen. The main thing is to give abundance of simple watery gruel, and nothing else whatever.

Inversion of the bladder in the cow may take place in consequence of excessive parturient pains. The patient should be slaughtered in most cases. The organ may, however, be returned after the straining pains have ceased.

Turning now from the consideration of the ox to that of human beings, by way of conclusion, we may say that the diseases of the urinary mechanism in mankind may often be guarded against by care. Our readers will perhaps know that it is not only because active *exercise* calls forth the functions of the various secretory and excretory organs—amongst which last the kidneys are to be reckoned as perhaps the most important—that it is to be regarded as one of the essential conditions of health in a normally constituted and healthy human being or animal, but also because in the case of mankind it certainly is a fact—and one, too, that is not very generally understood—that worry, anxiety, and excessive mental toil do bring on various derangements of the urinary apparatus. It will, then, be very clear to those who think about this matter that any causes which interfere with the due discharge of the excretory functions cannot but be productive of serious damage, and should, therefore, be avoided with the uttermost care.

It is a very great mistake to look upon the kidneys in the light of simple filtering mechanisms. True, they remove water from the system; but the substances contained in the fluid, and especially that which is called urea, are of the very greatest significance. It should be remembered also that the excessive mental work which some men indulge in cannot but produce in due course the most disastrous effects. That pernicious practice called *cramming*, which so many boys and girls, and young men and maidens—aye, and older people too—indulge in, or are subjected to, is most ruinous to the constitution. From every point

of view it is a very wrong thing indeed to overtax the mental powers. Far more dangerous is it to do this than to perform an unduly hard day's physical work. It is high time that all who have the power to do so should speak out, and even shout from the housetops, against the terrific evils, the monstrous inquisitions, the shatterings of the constitutions of boys and girls, which have resulted, and do result, from one of the most abominable and detestable of all modern excrescences. Need we say we allude to the examination craze.

How long will it be before parents begin to find out that the best work in the world, and even good work, has very, very seldom been evoked in response to the artificial and irritating stimulus supplied by examinations? In the case of the learned professions they may be necessary evils, but, when carried to the pitch now in vogue, they are responsible for the most disastrous ruin of many careers which might otherwise have been bright, and happy, and useful.

Cases of overwork are generally most clearly shown by damages to the nervous system and to the kidneys. Undue mental toil, especially if undergone immediately or soon after meals, will bring on indigestion, and incapacity for a continuance of work. If the urine is examined, it will often in these cases be found to be neutral and to contain suspended phosphates. There are, of course, other disorders of the kidneys in mankind, which from the frequency of their occurrence are only too well known. Of these we may here just mention that sometimes albumen and sometimes sugar escapes through the kidneys. The former of these diseases is known as albuminuria, which is synonymous, at least in very many cases, with Bright's disease, and the latter as glycosuria or diabetes mellitus. In fact, so usual is it that ill-health is associated with some disturbance in regard to the excretion of urine, that one of the first things which a careful physician will usually do will be to test the condition of this fluid. A healthy state of the kidneys, and the correct working of this excretory apparatus, are among the first essentials of healthy life, and the urinary mechanism is, moreover, one of those vital systems which on examination are often found to be out of gear both in man and animals.

SECTION VIII.—THE SKIN AND THE DISORDERS CONNECTED THEREWITH.

Alike in animals and in man, the possession of a beautiful and healthy skin is an enviable one. Not only does it impart an attractive appearance, but it also to a large extent implies a good state on the part of the whole bodily frame. This, however, must not be considered as an infallible sign, for many who are very great sufferers from internal disease may yet look thoroughly well in regard to the skin. Hence, although *cæteris paribus* a fine skin is a most desirable gift or acquisition, still the mere possession of it is not a certain and sure proof of health. On the other hand, an unthrifty look must always be considered as a mark of bad condition, of ill-health.

Furthermore, among mankind, perhaps, there are few persons who, rather than show a tell-tale complexion or an unsightly eruption on the hands or face, would not prefer to be afflicted with some minor ailment which would not be observed. The fact is, that the majority of people have a great horror of skin diseases, and they very often set them down as being far worse than they really are. No doubt some of this aversion springs from a kind of idea or belief that skin affections are, as a rule, parasitic in origin. Of course, this is by no means always the case, and it may be added that in the hands of a doctor who knows his work those diseases of the skin which are parasitic in character are for that very reason to be less feared than many others which but too often point to a general disturbance, or even the gravest possible diseases of the system at large.

Strange as it may seem, men, and even women, often allow skin ailments to proceed without seeking good and wise treatment at the hands of a clever doctor. Now, if this is the case among human beings—and that it is so cannot admit of serious doubt when one observes the large number of curable skin diseases in one's fellow-men—how little surprise need we feel when we find that many owners of oxen are by no means solicitous as to the cure of ringworm or other afflictions of the skin among beasts. No doubt, however, more care will be taken concerning these and allied points, so soon as farming begins to look up again, for which state of things we in England are all hopefully waiting.

There is some little difficulty in treating nicely and scientifically of the diseases of the skin. Although a great deal is known about the skin diseases of oxen—albeit much more remains still to be learned—yet there is not so very much which is of real practical utility, so far at least as science has already advanced in this direction. They are, in short, more interesting from the scientific than from the business-like point of view. Our readers will, of course, understand that this is very far from being the case in regard to the disorders which attack the human skin, the treatment of which has advanced to a high degree of precision. Yet the skin diseases of all animals present numerous points of relationship, and hence throw light upon those which afflict human beings.

One of the obstacles to a judicious consideration of our subject springs from the well known fact that the skin in all classes of animals suffers as the result of various general or blood-diseases, and consequently some kinds of eruption on the skin may, in whatsoever animal they appear, be signs of the severest of diseases. For instance, we find the skin of the ox attacked in cow-pox, epizoötic aphtha, purpura hæmorrhagica, scarlet fever, rinderpest, and so on. In our remarks we shall for the chief part confine ourselves to diseases of the skin, *quâ* diseases of the skin, and not in reference to their effects on, or their connection with, the system at large.

The ox's skin is tough and covered with hair, and it differs with regard to the closeness of its connection with the underlying tissues, being very loose in some parts, as, for instance, where it forms the dewlap. In a healthy animal it is soft and pliable, and the coat is glossy and smooth ; but in an unhealthy one it is very liable to become dry and also tightly bound down to the tissues subjacent to it. The ox is then spoken of as being " hide-bound." In these cases the sebaceous secretion whereby the glossy appearance is imparted in a healthy ox is imperfectly produced. Sometimes a mild cathartic dose may be very beneficial, but the primary cause should always be looked to.

Hide-bound is generally accompanied by a "staring coat," which is occasioned by the hairs standing more or less upright, the minute muscles which move them being contracted. This "staring coat," as it is very suggestively termed, is, however,

but too frequently characteristic of the beginning of a febrile disorder.

The skin may be roughly divided into three parts. Of these the most external is the cuticle, that hard portion which is so familar as that which is raised by the action of a blister. In this layer there are small pores through which the hairs pass. Next comes the rete mucosum, wherein the colouring-matter is deposited. Most internally placed comes the cutis or true skin, which contains nerves, blood-vessels, sebaceous and sudoriferous glands, and bundles of connective tissue. The sebaceous glands secrete an oily fluid, whereby that glossy look which is seen in animals which are laying on flesh and doing well is imparted. The sudoriferous or sweat-glands pour out the perspiration.

Now we proceed to deal with the disorders to which the skin is subject—first, those which are not parasitic, and then those which depend upon the presence of parasitic organisms, whether animal or vegetal. Speaking generally of them all, we may say that one very great point in regard to treatment is that the strictest cleanliness should be enjoined.

ERYTHEMA.

Simple erythema consists in a bright redness diffused generally over the surface of the skin, and more or less regularly exhibited. When pressure is applied, this redness disappears, but it is soon renewed after the pressure is removed. This affection is only rarely seen for many days as a simple erythema except in parts affected by parasites. On the contrary, in the general way erythema becomes complicated by the formation of vesicles or even of pustules. An erythematous skin may, in short, develop vesicles which may become confluent and may exude a gelatinous sticky fluid whereby the hair on the surface of the skin may be matted together. The vesicles may become pustular, and the skin may ulcerate, and slough off in parts. In some cases erythema remains simple, the cuticle is shed, and the skin again becomes healthy. In the case of patients which have died when suffering from simple erythema, the redness can be seen to be confined to the outer layer of the skin, as is shown if a transverse section be made, while the deeper portion is not as a rule much affected.

Now, simple erythema may become chronic, especially upon

the teats of sheep and cows, in which case the skin usually soon begins to crack, and from the thick edges of the cracks a thin gelatinous fluid may be exuded. This fluid may, it seems, infect the lips of lambs and calves. In the cow an erythema of the udder in some cases is, it seems, due to a constitutional specific infection, the vesicles which are formed containing matter which Mr. Power found to cause scarlet fever in man, and which Dr. Klein has fully investigated (*vide* "Scarlet Fever," pages 328–357).

When this condition affects the udder in a severe form, mere handling of the teat may produce very great pain, and in these cases the milk should be drawn away by means of a teat-syphon, and on no account should the milk be used for dairy purposes. The calf should be removed, and, if the mouth be affected, it should be dressed with a suitable preparation. The udder should be dressed with the ointment of Eucalyptus or that of salicylic acid. In some cases it may be well to apply a layer of

FIG. 74.—MILK-TUBE.

medicated cotton-wool to the surface of the udder, and to support this organ by means of a broad bandage tied round the back. A cathartic drench should also be administered, and other suitable measures should be carried out by the veterinary surgeon.

As we have just said, chronic erythema may manifest itself on the udders of ewes and on the lips of lambs, and it is generally met with in the spring, at which season the animals are plethoric. Chronic erythema may develop into an aphthous or ulcerous eruption on the lips and udders respectively, the disorder being transmitted from the one to the other. In these cases it may be found advisable to draw off the milk by means of teat-tubes or otherwise, and if the lambs are permitted to suck, the teats should at least be protected by means of a gutta-percha shield; for, if no such measure be taken, the teats may, by reason of the rough usage to which they are subjected, be very deeply eroded. When this is the case, the best plan is to

put the ewes on a scanty pasture apart from the lambs, and to apply to the affected parts both at night and in the morning a mild antiseptic ointment, such as that of boric acid or that of salicylic acid, previously washing away with warm water the dirt which may have collected.

Again, sheep may be afflicted with an eruption of ulcers on the lips and on the legs, and so great may be the disturbance thereby engendered that the animals may actually die; but, if so, we shall generally find on examination that there has been a more probable cause of death, namely, disease of the lungs. In other words the fatal issue was probably brought about by the lung mischief. Now, it is of great importance to note that in Canada the aphthæ have been found in connection with (and probably in causal connection with) a microscopic living animal, an amœba, one of the simplest and lowest of all animals. This same microscopic animal was also found to be present in the water wherein the sheep often stood. Dr. Dallinger's investigations would seem to indicate that the amœbæ are intermediate conditions of a great number of monad forms of life. The elucidation of the life-history in such cases requires a vast amount of patient and able research. An ointment such as that of boric acid or that of salicylic acid may be applied to the affected parts, and the sheep should be well sheltered, and good food in fair amount should be supplied to them.

ERYSIPELAS.

This disorder manifests itself by a diffuse inflammation of the whole thickness of the corium, sometimes also involving the subcutaneous connective tissue. Pain and febrile symptoms are exhibited. Erysipelas may be brought on by injuries, by strong external applications, by burns, scalds, &c. The skin is very red, and this redness does not disappear when pressure is applied. The tissue underneath the skin is also inflamed, and the inflammation may disappear, or on the other hand it may go on to ulceration, mortification, or gangrene. It is well to give a cathartic drench, and to apply suitable soothing preparations to the inflamed parts. Simple lard may do good if nothing better is at hand. Some veterinarians have recommended that the affected part should be demarcated from the rest of the skin by applying a strong solution of nitrate

of silver along its outer margin. We have no faith in this method.

Erysipelas in sheep likewise is a disorder which consists in a diffuse inflammation of the skin and areolar tissue coupled with febrile symptoms. Simple erysipelas may occur in all animals; but it seems to be more especially liable to break out in sheep and dogs. A sheep in a plethoric condition may suddenly have its secretions arrested, or may receive an injury or injuries, as for instance during the process of being sheared, or may have cracked heels, and as a consequence of any of these causes it may suffer from erysipelas. A stimulant such as the sesquicarbonate of ammonium and an aperient such as about three ounces of Epsom salts may be administered to a sheep, and an antiseptic ointment may be applied locally.

ECZEMA.

If an animal is suffering from this complaint a number of vesicles appear, in certain parts, on the skin, and the hair is denuded. There is a great deal of itching, and the rubbing, which is the consequence, renders the parts raw and red.

FIG. 75.—CHRONIC ECZEMA. *Psoriasis or Rat-tails.*

Luxuriant growths of vesicles succeed each other. If the disease becomes chronic, the skin thickens and cracks. The fissures may even become long sluggish ulcers. The growths called "rat-tails" may be produced, especially on one, two, three, or all four legs. So great may be the damage, that the hoofs may even slough. The patient should be kept in com-

fortable quarters, be well attended to, and at first treated with laxative medicine. The parts may be dressed with suitable preparations, containing lead and morphia. Regularly supplied good food and strict cleanliness should be enjoined.

We are inclined to entertain the belief that many cases included under the name Eczema take the distribution of nerves, and are of the same nature as is Herpes in man.

HERPES CIRCINATUS.

In this disorder vesicles similar to those of eczema arrange themselves in a gradually widening circle. Several rings of vesicles may be formed. The vesicles burst, and the fluid discharged dries and forms brown scabs or scales in about eight and a half days, and the redness of the skin beneath gradually dies away. The disease is not so common among oxen as it is among horses.

IMPETIGO LABIALIS.

Eruptions may occur on or near the lips of young animals, *e.g.* calves, lambs, young goats, and pigs. Round pustules may frequently be seen on the lower lips of lambs. These may be thickly studded, and become confluent. They may burst, and the pus then forms a thick incrustation or scab, and after a few days the scab may drop off, thereby exposing the corium greatly inflamed. Calves especially suffer from impetigo on the upper lip extending to the mucous membranes of the mouth and nostrils. The malady may possibly be due to the richness of the milk which the young animal receives from the mother, or may be owing to the acrid and irritating nature of the green food, *e.g.* to some of the acrid plants which may grow in pastures. For instance, lambs which are folded on long grass very wet with dew or rain suffer from excoriations and pustules in the region of the mouth, and, under such circumstances, may also display febrile symptoms. In such instances it is advisable to change the diet at once.

Impetigo may also affect the face and lips of older animals out at grass. An eruption of pustules may appear, and beneath them there is a severe inflammation. It is advisable to change the pasture, and a suitable ointment should be applied to the parts. A drench of cathartic medicine may be useful.

URTICARIA OR "NETTLE-RASH."

This skin affection comes on suddenly and disappears suddenly. It shows itself by a number of elevations of the skin about two and a half inches in diameter on the average. The itching produced is great, the temperature of the part affected is slightly increased; but there is little or no tenderness or fever. Cattle that have been badly kept in winter and have quickly become plethoric are most liable to be attacked with nettle-rash in the hot summer-time following. The hair is shed after a few days, producing many bald patches, and the eruption may disappear after about twelve days. A fairly strong saline cathartic should be given, and a lotion containing glycerine, carbonate of sodium and laudanum may be useful for applying to the affected parts several times daily. Sulphur and bicarbonate of potassium may be given in the food. Cleanliness and comfort are essential.

PRURIGO.

Prurigo is the disease sometimes known as "Spring-lice." It is often met with among cattle, especially during the early parts of the year. In cases of this malady the coat stares, the papillæ of the dermis are inflamed, pimples appear on the body and legs, crusts are formed, and then thrown off together with the hair. The treatment is the same as that for urticaria.

ECTHYMA.

Ecthyma is rare among cattle. A number of large prominent and isolated well-defined pustules appear. They burst, and pro-

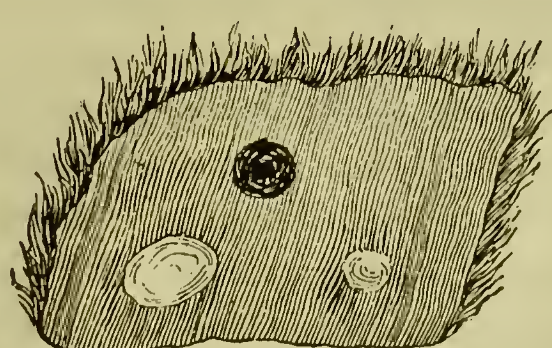


Fig. 76.—Ecthyma.

duce a dark-coloured scab, which, on being detached, leaves a brown stain. The pustules may often be seen on those parts of

cattle which are covered by thin skin and few hairs, as upon the udder. The disease is liable to be mistaken for small-pox. The treatment should be similar to that for urticaria.

This disorder of the integument in sheep, Ecthyma, has been given to a pustular eruption which often breaks out in sheep in the summer-time. The pustules are small and pointed, and they ultimately dry up without leaving any scar. The eruption is coupled with very little general disturbance of the system, and it is not of much importance except on account of the fact that the pustules may possibly be mistaken for those characteristic of the very serious disease—sheep-pox. The term acne has also been applied to this affection in animals.

FURUNCULUS, OR BOIL.

A boil is a small circumscribed swelling of the skin and subcutaneous tissue, acutely inflamed, and having a central portion which becomes gangrenous and requires to be removed. This removal may, however, be safely left to nature to effect, or it may be well to apply poultices or fomentations with a view to hasten the process and relieve the pain.

CARBUNCLE.

Carbuncle differs from the preceding, mainly by reason of the large amount of tissue which dies. The dead parts should be removed by the knife, and antiseptic dressings should be used. Stimulant tonics may be given internally.

PEMPHIGUS.

This word means a *bubble.* The skin gives out bladders in all parts of the body, varying in size up to a fowl's egg, and containing serum, or in severe cases pus and blood. A portion of skin which is perfectly free from these bladders may be covered with them in a few hours. They may disappear as rapidly as they are formed, they burst or possibly dry up without bursting, and their walls in drying form a thin brown scab, on the removal of which the skin below may be seen to be red. The disorder may become chronic, and last for months. Gentle purgatives and afterwards alkalies are to be recommended. The bladders should be opened, and astringent powders such as starch, or the oxide of zinc ointment should be applied.

PITYRIASIS.

Pityriasis is the name given to a scurfy condition of the skin most frequently seen in young animals. A mild sedative ointment and a change of diet are to be recommended.

NÆVUS.

Nævus is the name given to a slight swelling or tumour composed of blood-vessels. There is also generally some hypertrophy of the superficial layer of the dermis.

WARTS OR ANGLE BERRIES.

Warts or angle berries vary in size from that of a pin's head to that of a large apple. They should be carefully removed by means of the knife or the écraseur, and the bleeding, if necessary,

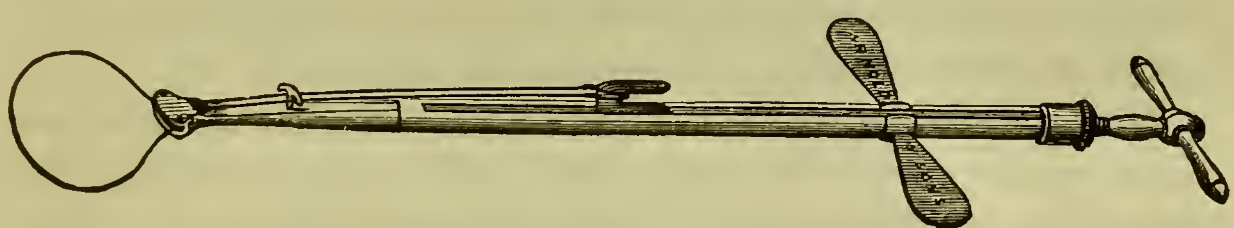


FIG. 77.—ÉCRASEUR.

may be stopped by the application of the hot iron. They may also be removed by ligature.

ALOPECIA.

Alopecia, or falling off of the hair, may sometimes be cured by mild repeated stimulation, such as by tincture of cantharides.

ŒDEMA.

Œdema, or anasarca, or dropsy of the subcutaneous tissue of the lower parts of the body, is not very rare in cattle. Careful nursing, rubbing with the hand, and the administration of small doses of digitalis may do a great deal of good.

EMPHYSEMA.

Emphysema is the name given to a condition of the skin caused by the escape of gases resulting from decomposition into the subcutaneous areolar tissue, as may be seen in some cases of

black-quarter. A stimulant may be administered, the surface may be rubbed, and in certain cases the veterinary surgeon may think it well to make incisions through the skin. It is generally associated with marked debility in animals, and is best treated by careful feeding.

Before we conclude our consideration of the skin by a discussion of those which depend upon parasitic organisms, both animal and vegetal, we wish to insist upon a very noteworthy fact, and one which very many persons lose sight of, namely, that the three intimately connected sciences of therapeutics, medicine, and surgery, have in quite recent times made immense advances towards perfection, and are still moving onward day by day. So certainly and so much is this the case, alike in human and in veterinary practice, that it seems nothing less than strange and well-nigh incredible that there are still some people who are not slow to say they do not believe in medicine, and that those who practise the avocation of healer, whether of men or of animals, are sometimes not doing much real good.

Now, this is very far indeed from being true, and such statements could never be made by those who can realise and appreciate the far-reaching improvements which have been, and are being, made. The fact is, that these sciences, so far from lagging behind the other pursuits of mankind, are holding their own in the very foremost ranks of progress; and, indeed, the ends to be gained, the results to be achieved, are of the first importance to human health and human happiness.

Just to give one instance, selected almost at random out of many, we may point to a single quite modern therapeutic appliance which is of the utmost value to mankind—we refer to the new local anæsthetic, hydrochlorate of cocaine. We need only remind our readers that by the local use of this drug certain operations are rendered painless, without the person or animal being rendered comatose, a condition of the administration of chloroform, ether, and nitrous oxide. For operations on the eyes of man, no less than of horses and dogs and other lower animals, this salt is of very great value indeed. Similarly, for the removal of small tumours and other abnormal growths, the use of this new local anæsthetic is of wonderful practical utility, and cannot fail soon to come into very general use.

This, however, is only one discovery; and we might write

columns and columns on new drugs and appliances of yet more paramount importance. There are others of still higher significance than is hydrochlorate of cocaine, and it may be said, without the least shade of a fear of contradiction, that, if the science of medicine continues to progress in the course of the next fifty years as it has undoubtedly progressed in a wondrous degree during the last half century, our successors will indeed have good reasons to congratulate themselves upon the immense powers they will be able to wield over the insidious yet manageable onsets of disease, and the premature threatenings of the clutches of the ghastly monster, death.

Assuredly, we have no hesitation in affirming that the same sciences, in so far as they bear upon the disorders of lower animals, have in like manner made rapid and sure ascents up the steep and arduous hill of discovery; and it may be also very appositely advanced that there are some cases in which these latter acquisitions have helped on the knowlege possessed by those whose avocation is that high and ennobling one, the cure of human disease and the alleviation of human suffering. As years roll on, veterinary science must and will occupy one of the highest positions, and those who are engaged in it will be fully and adequately recognised as workers in the great cause of science at large.

MANGE.*

The disorder known under the appellation of mange is contagious, and due to the presence of a minute acarus in numbers on the skin, and to the ravages produced by their burrowing their way from the surface into the cuticle.

According to Gerlach there are two forms, viz. the *Dermatodectes bovis* and the *Symbiotes bovis*, of which the latter is rare and the former frequent. Our readers will understand that the mange-spider of the ox is different from that of the horse, from that which causes sheep-scab, and also from the *Acarus scabiei* of man. In short, each animal is liable to be infested with its own peculiar acarus living parasitically upon the skin, and this acarus cannot become parasitic upon the skin of another animal, though it will maintain vitality for a time. The Dermatodectes of the ox is very frequently first found upon the withers and the

* Scabies is mentioned under "Parasitism," see pages 437 to 447.

root of the tail, and from these parts it extends over the body. The hair of a mangy ox will come off here and there, and if the dry scales which are present be removed, small raw pimples discharging a yellowish serous fluid may be seen.

In order to be absolutely certain that the disease from which an ox is suffering is really mange, a little scurf may be removed,

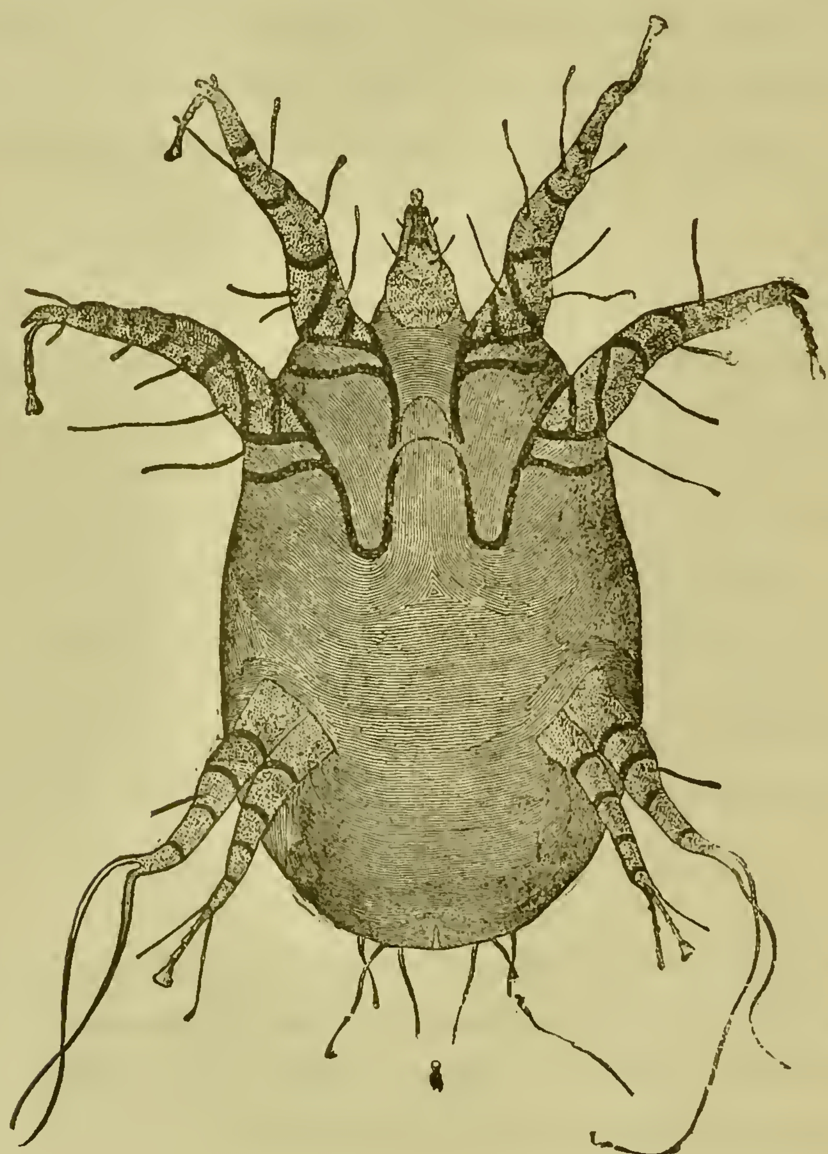


FIG. 78.—DERMATODECTES BOVIS (*Gerlach*).

and should then be very carefully examined under the microscope, in which case the acari may be observed. The acari can sometimes even be seen by the aid of strong sunlight with the naked eye as minute white points moving about rapidly. In chronic cases the skin becomes thick and thrown into folds, especially in those parts, such as the neck, breast, and thighs, where it hangs loosely. The disease is more common among debilitated, and especially among badly kept, animals, than among those which are well looked after and in good condition. It is to

be well remembered that one ox afflicted with this complaint will spread the disorder throughout the members of a herd, and hence any ox observed to rub itself on account of being mangy should at once be removed from the rest, and set apart to be cured. All clothing and other things which have been in contact with a mangy ox should be either destroyed or well purified by submitting them to the influence of moist heat.

TREATMENT.—The skin should first be well washed with soft soap and warm water. Some of the preparations used for the cure of this disease are very poisonous, and apt to work far more damage than the disease itself. Tar, or infusions of stavesacre or of tobacco, are safe remedial agents. A change of the application is sometimes advisable. Sulphur ointment (made of one part of sublimed sulphur mixed with four parts of benzoated lard) if thoroughly applied every other day or even twice a week for a sufficiently long time over the skin, but, of course, especially on and near the parts affected, will be found to be an efficacious, reliable, and pefectly safe remedy.

Mr. J. R. Dobson, M.R.C.V.S., in his valuable little book on *The Ox*, recommended a preparation made up of equal parts of oil of tar, oil of turpentine, and linseed oil, well mixed, and well rubbed into the skin by means of a brush every day. Before each dressing, the skin should be well washed with carbolic acid soap and warm water. Many owners of stock find it impracticable to have animals dressed with sufficient frequency and due care; but mange is a disorder which cannot be cured except by frequent applications, continued for some length of time. A good preparation may be made of sulphur (1 oz.), oil of stavesacre (1 fluid drachm), and of lard (2 oz.).

"PHTHIRIASIS, OR LOUSINESS."

Lice are liable to affect oxen. There are several different kinds. If the skin be washed with infusion of tobacco, the lice may gradually be poisoned. Before each dressing, the skin should be well washed. Care must be taken that these pests do not get on to the skin of men, or animals which may be near. Another useful preparation may be made by boiling stavesacre seeds with soft soap and water, or by taking five ounces of stavesacre seeds and boiling in a gallon of water, until only about two quarts remain.

WARBLES.

We have already treated of Warbles rather exhaustively under the heading "Parasitism." (*Vide* pp. 431 to 436).

RINGWORM.

This very contagious disease shows itself by a number of round scabby patches about the size of half-a-crown. If they are peeled off, a raw surface is exposed, whence a yellowish fluid exudes, by the drying of which the scabs are formed. The rings may unite to form large patches. They are generally seen about the head, especially around the eyes (producing a grotesque kind of spectacled appearance), behind the ears, on the shoulders, neck, back, and thighs, and, indeed, all over the body. The disease produces a very unsightly appearance, and owners who value the look of their herds should therefore employ measures to rid their oxen of the complaint. There are two kinds of ringworm, viz. *Tinea favosa* and *Tinea tonsurans.*

Tinea Favosa.

Tinea favosa is the name given to that kind of ringworm which is caused by the fungus *Achorion Schönleinii*, the origin of which is due to spores which have penetrated hair-follicles. The spores gain entrance into the hairs as well as into the cuticle. It is said not to originate in oxen, but to be rather easily transmitted to them from other animals. The crusts should be removed, and the underlying parts should be dressed with one fluid part of diluted sulphurous acid, mixed with about three fluid parts of glycerine.

Tinea Tonsurans.

Tinea tonsurans is the name of that kind of ringworm which is produced by the more simple fungus *Trichophyton tonsurans*, which does not project as cups on the surface, as in the case of *Tinea favosa,* but is manifested by the presence of a fine powder on the skin. It is capable of being transmitted not only from one ox to other oxen, but also to other animals and to human beings. Hence great care must be taken. Circular patches, devoid of hair, are seen in various parts, and the skin is seen to be scurfy, especially in the centre of the patches. The same

treatment is to be recommended; the pharmacopœial ointment of iodine is very valuable.

Tincture of iodine may be painted on with a stiff hair-brush. Hyposulphite of sodium has also been found to be efficacious.

SECTION IX.—VITAL MOVEMENT AND THE DISORDERS OF THE ORGANS OF LOCOMOTION.

We have not very much to say under this heading in relation to the sheep and the ox, partly because what might fitly be introduced under it is otherwise classified, and need not be repeated here, as for example an account of Foot-and-Mouth Disease, and also a consideration of some surgical disorders.

Before we commence our subject proper, it seems not out of place to say here a few words respecting the very important subject of the causation of vital movement, which we accordingly proceed to do forthwith.

THE CAUSATION OF VITAL MOVEMENT.

Dr. W. Kühne, Professor of Physiology in the University of Heidelberg, has for thirty years been engaged in investigations concerning the terminations of nerves in muscles, and the ultimate structure of muscles in many classes of animals. Movement is an attribute of all living matter, of protoplasm, whether animal or vegetable; and every living cell is spontaneously active. The movement may go on in opposition to gravity, and may overcome frictional resistance, and it results from chemical processes taking place within the protoplasm itself, which processes may be to some extent determined by outside forces. Protoplasm reacts to stimuli just like muscle does, and electrical stimulation especially first strengthens the movements, and then brings the mass into a form having the least surface, *i.e.* a sphere, as a result of prolonged maximal contraction. We must look upon all movement as either originating automatically, *i.e.* as a consequence of internal changes, or by external stimulation. Even oxygen seems to be not actually necessary for movement in some kinds of protoplasm. At any rate that gas can be dispensed with for long periods. Delicate gradations can be traced betwixt the most homogeneous and formless protoplasm, through

cilia and flagella and the primitive muscles of infusoria to the highest forms, showing that fully-developed muscle is actually poorer than elementary protoplasm, in the point that muscle is wanting in automatism and elementary nervous properties. The muscle-cell is not complete without the nerve-cell connected with it by the continuous nerve-fibre, which may be several feet long. Hence we have two separate cells united only for one purpose, one being the nerve which excites, and the other the muscle which obeys. It has been proved that nerve-branches are not always present. Professor Kühne has shown that small pieces of fresh frog's muscle in which no nerve can be detected by osmium-gold staining, whereby the finest nerve-fibres, if present, can be displayed, neverthless twitched at each stimulus not below a certain stimulus, and he has also proved the fallacy of the statement that everything which excites the nerve makes the muscle twitch, and *vice versâ*. Furthermore, the same distinguished scientist has shown that motor nerves can conduct centripetally, *i.e.* in a direction opposite to that in which impulses generally travel along them; also that the absence of nerves from a portion of muscle can be absolutely proved by a physiological test, and that it is not possible to excite the motor nerve of a muscle-fibre by any stimulus to the nerve-ends within the muscle-fibre. Moreover, the excitement or contraction of a muscle does not travel back into its nerves. The great majority of muscle-fibres are entirely free from nerves, the nerve-endings being confined to very small tracts termed fields of innervation. Hence muscle-fibres possess the power of propagating their own excitation, the velocity of conduction being from one-third to one-tenth of what it is for nerves. Thus the nerve only introduces a stimulus to the muscle, which propagates it by its own independent irritability in every movement and throughout life. All the different kinds of stimuli, except those which are gaseous, which are capable of acting on muscle are capable of being resolved into the setting up of electrical currents. Hence all irritability can be reduced to reactions to electrical processes, and hence vital electricity is of immeasurable importance. Nerve-endings in muscles show the hooked forms of their branches turned as a rule towards each other, and also the direct contact of the nerve-end with either the transversely striped contents of the fibres or with the protoplasmic sarcoglia

which traverses and penetrates it. The muscle-wave commences in the field of innervation, and has indeed been actually fixed by sudden hardening of muscles. Du Bois-Reymond has been able with the galvanometer to render the excitation of nerves, not attached to muscles or ganglion-cells, evident as the negative variation of the natural nerve-current, to cause movement of a magnetic needle instead of a muscle, or to put the movement of the needle in the place of sensation. The currents of action of muscle were a long time ago proved to excite nerves, and there are similar effects from nerve to nerve. Kühne has succeeded in practically uniting two muscles, the nerves of which had been poisoned by curare, so that they acted as one. Stimulation and contraction were propagated from one end to the other. Any electrical insulation stopped the current, and hence the first muscle must previously have excited the second electrically. It seems, then, that muscle is ordinarily excited by actual electric currents, and not merely by forces resembling electric currents.

RHEUMATISM IN SHEEP.

We include, perhaps not altogether correctly, *rheumatism* in this group of disorders of the organs of locomotion. Rheumatism usually breaks out in sheep in consequence of careless and cruel exposure of these animals to wet and cold weather. As might be expected, the disease is markedly prevalent in low-lying, marshy districts, and, in fact, in all exposed situations; and it is most generally met with in inclement and tempestuous weather. In the general way it attacks old sheep or very young ones. Occasionally rheumatism may manifest itself in an acute form, when it is attended with severe febrile symptoms. More usually the malady is chronic in character, and the walk may be noticed to be stiff and cautious. If this is the case, the disorder is not often completely eradicated.

We have previously considered somewhat in detail the disease known as foot-rot. Now, in addition to this affection of the organs of locomotion, there are two others connected with the same mechanism of locomotion which require a brief description at our hands. These are arthritis or joint-ill, and rickets. We also propose to discuss briefly a lamb-disease which broke out in America in the spring of 1862. Possibly it was nephritis.

ARTHRITIS.

Arthritis is often met with both in this country and on the Continent. It is indicated by a stiffness of movement, a tendency to lie down constantly, swellings coupled with heat and pain in the knee, hock, and stifle, joints. Febrile symptoms are manifested, the animal loses appetite, becomes emaciated, suffers from diarrhœa, and may die within a few days. The application of cold, followed by the use of tincture of iodine, are beneficial, and in some cases aperients may be given. Some persons recommend tonics together with plenty of nourishing gruel and other laxative diet. Should the disease be rheumatic in nature, it may be well to apply counter-irritants locally and to administer alkalies and salicylates internally.

Lambs from two to five weeks of age are very liable to swell at the joints. Most frequently the knee is affected, the fetlock is sometimes involved, while occasionally the hock is the seat of disease. The joints are very much swollen, stiff, hot, and painful. The animal is frequently stiff all over before the actual swellings are seen, and it may crawl about on its knees, or even be unable to rise from the recumbent posture. As a rule the animal does not struggle much, but wastes away, and in most cases either dies or else becomes incurably lame and worthless. The malady is engendered by damp and cold, and the best remedial measure is the application of warmth. The lambs should be sheltered, their little limbs should be well stimulated by means of a suitable embrocation, and also kept quite warm ; their bowels should be kept open by suitable aperients, administered in very small doses, and cordial medicine should be given in hot gruel.

If the animals are very severely affected, and especially if the knee is attacked, the joint may swell and fill with fluid, which may become purulent. There is a general enlargement of the limb, and eventually a stiffened joint. At or soon after their birth, calves as well as lambs are very apt to suffer from this kind of disease of the joints, which has the character of rheumatism. This affection must not be mistaken for scrofulous joints. In scrofulous lambs it frequently happens that the joints are diseased at birth, or very soon after birth. If it is decided to treat the case, salicylate of sodium or acetate of ammonium in suitable doses may be tried. Moreover, starch

bandages may be wrapped around the swollen joints. Should the swellings become chronic in nature, preparations of iodine or ointment of cantharides may be applied.

In this connection we may again point out how highly important it is that sound breeding stock should always be selected. Indeed, it is most necessary that the greatest possible care should always be used in reference to the selection of animals for breeding purposes. On no account should breeders employ for that object sheep which have a thin neck, narrow chest and loins, pot-belly, tender eyes, very small bones, and fine wool distributed over the head, belly, and legs. It is also very essential that sheep should be provided with good food, and that they should take a sufficient amount of exercise.

FOUL IN THE FOOT.

Having completed our sketch of the skin diseases liable to break out among oxen, we come now in due course to a consideration of the disorder known as foul in the foot, the only affection of the foot which needs discussion at our hands. The degree to which this complaint advances varies a great deal. It is not so very uncommon to find that a highly fetid discharge issues from the cleft of the hoof, wherein a raw unhealthy surface or sinuses may be observed. Portions of the hoof may come off, and leave an exposed bleeding surface, which may suppurate and even ulcerate. Fungoid granulations may arise, and these may extend to the back part of the foot, and to the heel. The fetlock may swell, and the animal may suffer intense pain, so much so, in fact, as scarcely to be able to bear to put the feet to the ground. The general health also suffers greatly, the animal losing appetite, and, if a milch-cow, giving less milk.

CAUSES.—The horn, if growing irregularly, may split, or it may cause rupture of tissues internal to itself. If cracks or fissures exist, dirt may collect and bring on inflammatory action. Again, a stone or other foreign body may get lodged into the cleft of the hoof. If so, it should be removed, and the part should be well cleansed and anointed with some simple soothing unguent. Otherwise, the irritation set up, being continued for some little time, may give rise to the formation of pus, and if this pus is closed up so that it cannot escape, as may easily be the case, it becomes very offensive, and causes extension of inflammation

into the adjoining parts. The most usual source of this affliction of the foot is wet, whereby the hoof is first softened, and then irritated and inflamed by protracted exposure to the three potent influences for mischief—dirt, wet, and cold. Again, in some cases the disease may spring from a rupture or other affection of the ligament which connects the two divisions of the hoof. Inflammation of the secreting glands and coronet may succeed upon injuries to this ligament. Pus may be produced, and burrow down among the bony tissue of the foot within the hoof.

TREATMENT.—Great care and the strictest cleanliness are indispensable. The patient should be kept up in a clean, well-built shed, the floor of which should be quite level, only so far sloping as to allow of drainage away from the animal, and nicely bedded down with good dry straw. The space between the claws should be examined and well cleaned. If the upper edges of the hoof or other portions of it are diseased, or broken and loose, so as to favour the collection and imprisonment of pus, they should be removed by means of a suitable sharp paring knife. When the diseased parts have been carefully cut off, the feet should be placed in linseed poultices, with which a suitable mild antiseptic may be mixed. If it is preferred to do so, the hoof may be nicely wrapped round with antiseptic tow or lint, and secured in position by means of a bandage passed between the claws and tied round the leg above the foot. A good and simple ointment for foul in the foot may be made of one part of boric acid mixed with seven parts of lard.

We pause here to reiterate the necessity of thoroughly draining the land. If this measure were always well carried out, farmers would save a great deal of money in many different ways. For instance, the disease of which we are now treating would be much rarer than it is. Sometimes sheep or oxen may be unavoidably kept on damp ground. When this is the case, Mr. George Armatage, M.R.C.V.S., recommends the use of the following ointment once or twice a week :—Melt 1 lb. of Burgundy pitch, with 1 lb. of mutton suet, over a slow fire, and then add 1 lb. of Barbadoes tar, and mix thoroughly.

LAMINITIS.

Laminitis is not often met with among cattle, nor is it of very great importance when it does occur in an ox. The disease may

be treated with a cathartic drench, rest, cold-water applications, and with suitable internally-administered remedies.

SECTION X.—THE EYE AND THE EAR AND THEIR DISORDERS.

THE EYE AND THE EAR.

Of the various channels wherewith we human beings, in common with animals, are enabled to communicate, and, so to speak, to converse with the great throbbing heart of Nature, the chief are these two organs, the eye and the ear, which, limited as they undoubtedly are, are yet wondrously perfected and marvellously fashioned for the purposes they so well subserve.

Speaking of mankind, we may say that this is especially true, for in healthy human beings the most complex parts of these important mechanisms of sight and hearing, *i.e.* the arrangements in the central receptive structure, the brain, are of amazing exactitude. Sometimes even we seem to hear and see the inmost heart of the great Mother Nature herself, to realise in all their weird intensity, in all their sublime and thrilling splendour, the beautiful mysteries spread before our gaze.

There are times in the lives of most of us when we stay awhile in our career towards that inevitable end which will soon come to all of us, and stand, and listen in solitary silence to the solemn sounds of the music of the universe. At such times as these the Eternal Spirit seems verily to speak to us, and with us, to answer our searching inquiries ; then, indeed, we seem to see her inmost heart, we hear her wild shouts of rejoicing, her subdued and calm sorrow, we feel her melancholy, her unfaltering resignation, and thus we, too, are led to meet all things that shall be and must be, rejoiced beyond measure to think and know that sooner or later all must be well for those who never cease striving to do wisely and well.

We hear the quiet sighs and silvery whispers, and heavy wails and dull, leaden croaks of sadness and misery and despair, and now a joyous chorus of exultation, as the huge star-bespangled wheel of the universe turns slowly but surely round and round and round. A message, a mission seems to be sent to each

listener from out the far-off distance, an irresistible word of command that we should, each and all of us, so far as in us lies, help each other upwards, onwards, and distribute the good things we possess to this man and to that man, and to all men that on earth do dwell.

Then, indeed, do we see with clearer vision the world with all its manifold wonders standing out in boldest relief. The countless objects of irresistible beauty which meet our gaze seem to tell us of some central secret and deep reality underlying all that first strikes upon our view, something far deeper, and clearer, and higher, and truer than we can fully grasp. It is only now and again that we can see and hear and think these things; for men's states of mind vary greatly, and just as their lowest powers of perception differ from their highest, so do their lowest differ from those of animals.

The powers of vision and of hearing which animals possess are probably very dissimilar and wide apart from those of mankind. They lack many of the mental elements. We remember being struck with a remark of the late Mr. Thring's, in his admirable little work on *The Theory and Practice of Teaching*. He points out that a specially educated eye is requisite for the seeing of certain objects. For instance, a book-worm, out for his first day's shooting, may probably experience some difficulty in seeing exactly the objects of his search at long distances, the birds of the air as they are flying away from or towards him, and possibly he will fail to observe a hare or a rabbit which his companion, the sportsman, on the contrary, sees so well as to be easily able to take an unerring aim.

This is undoubtedly very true, and it is equally indisputable that an educated and trained ear is necessary, in order that certain sounds and combinations of sounds can be heard and properly appreciated; but there is another still more important point to be carefully noted. Probably it is not so much the actual seeing and hearing, *i.e.* the actual reception of sights by the eye, or of sounds by the ear, as the correct mental analysis and arrangement and representation by the brain of the things heard or seen, that are most difficult of attainment. In short, it may be urged that there are two distinct aspects both of seeing and of hearing, and even that the two processes are in some measure antagonistic.

A dog, perhaps, hears, sees, scents, more keenly than a man does; but the mental processes going on in the canine brain in connection with the sights, sounds, and smells are of a very direct, definite, and simple kind, and are very different indeed from the mental conceptions of a human being subjected to the same or similar influences. Hence, in animals, and among savages, the kind of perception of sights and sounds and smells which most directly conduces to direct self-preservation is that which is most strongly possessed, and it is also this kind which civilised human beings and domesticated animals have already in many cases lost in great measure, and which they will probably lose still more markedly, in proportion as the need for the exercise of those particular faculties is removed.

On the other hand, the savages and the lower orders of mankind are certainly more keen, in so far as their faculties of hearing and seeing subserve direct self-preservation than more civilised and more highly cultivated human beings are. This is, in fact, a necessary order of things; for if the savage's brain were occupied in unravelling the ins and outs of complex harmonies and melodies, he would be liable to be tardy in getting out of harm's way, and would probably soon be removed from this world for ever.

Now civilised men and women have usually plenty of leisure for acute analysis and introspection, and consequently they have clearer mental views of what they see and hear, albeit this may sometimes be at the expense of a less acutely sharpened readiness in seeing and hearing. What they do see and hear, they have an accurate and full perception of; but, at the same time, they may be slow in regard to hearing and to seeing.

Of all the organs of sense, perhaps the most complex and most marvellous is that by means of which we see what exists and goes on around us. Probably none know so well the transcendent pleasure of seeing as those who, having once possessed good eyesight, are afterwards debarred by some illness or some accident from the delights of vision. Not only is it an almost indispensable necessity that we human beings should see the things near and about us; but—and this is a point of great importance—it is one of the greatest and purest pleasures of which the human mind is capable to revel in the sight of the beautiful prospects open to our view.

Who has not felt at times that this is so? What man or woman has ever seen the picturesque sights of the world and has not felt joy at beholding them? These beauties, too, are not far to seek. Any of us can enjoy them with but little effort. The sky is always above us, and it is full of glorious combinations of colouring. The sea is never far away from us in England, and what a beautiful sight—ever fresh, ever magnificent, ever solemn and sublime—does it present! Happy are those who can derive their joy in living in some measure from the natural wonders of the world, wonders of sight and of song; for the earth is full of grand harmonies, if we could but hear them! Does it not, then, seem a most important avocation—that of the specialist in ophthalmic science? The man or the woman who has been made to see again—how thankful and grateful ought he or she to be to the benefactor who has indeed acted as a friend in need!

There are very many disorders of the eye thoroughly well known, and all or nearly all can be remedied, while many of them can be actually cured. The local use of cocaine has simplified some operations, and the removal of a cataract is in these days much more easily and effectually performed than was formerly possible. In the case of human beings, the eye has received—as it deserved to receive—the most patient and prolonged investigation, and ophthalmic science may be said to be now well-nigh near perfection, though doubtless there are new discoveries to be made and points yet remaining to be cleared up.

We cannot suppose that the eyes of the lower animals can ever attract the same degree of attention. Except by way of comparison with the disorders of the human eye, the disorders of the eyes of lower animals can only be looked upon as of secondary importance. Yet we find in actual practice that one meets with more ailments of the eyes of lower animals requiring treatment than we might expect would be the case. The disorders of the eyes of horses, indeed, are of very great importance, and even those of the sheep now merit some little attention at our hands.

Now, the organs of sight in higher animals are specially protected, being each embedded in fat and enclosed in a specially constructed bony cavity called the orbit, which is most wonder-

fully well suited for guarding the eye from all ordinary chances of injury. Attached to the sclerotic, by which name the outer covering of the eye is denominated (that transparent circular portion in front, called the cornea, being excepted), are various muscles which, by their contraction, move the eye, and turn it in various directions, and even draw it backwards. The capsule or outer covering of the eyeball is composed of the above-mentioned transparent and circular cornea in front, and this is continuous with the dense white coat called the sclerotic behind.

Situated internally to this external membrane, comes the choroid coat, to which is attached the circular muscle called the iris in front. This structure, the iris, is not quite continuous; it is, so to say, perforated, and the perforation is called the pupil. The iris imparts the colour to the eye. It may be said to act the part of a curtain, since, by means of contracting and dilating, it regulates the amount of light which enters the eye.

In the eye itself are certain refracting media, transparent solids and liquids (called the humours) of the eye, and these transmit and refract the light. The aqueous humour may be seen to gush out if the cornea be cut. Again, the crystalline lens is formed like a magnifying glass to collect into a focus the rays of light which fall from divers sources upon the eye. The vitreous humour is jelly-like and highly transparent, and occupies the posterior chamber of the eye.

The retina is a complex layer of nerve tissue situated at the back of the eye, and most internally. It is in reality an expansion of the optic nerve, and it receives the images of external objects, and transmits them to the brain.

In front, the eyeball is covered with a continuation of the lining of the eyelids called the conjunctiva. As for the eyelids themselves, they protect the eye from an excess of light, from dust, and dirt. Moreover, the ox is, in common with several other of our domesticated animals, possessed of a structure called the haw, a cartilaginous membrane known scientifically as the *membrana nictitans*. This structure is capable of being voluntarily passed over the eyeball, whereby any foreign body which may have become lodged there by accident can be cleared away. The surface of the eyeball is moistened by the tears secreted by the

lachrymal gland, from which they are conveyed to the eye by the medium of the lachrymal duct.

In reference to inflammation of the eye, we must remember that the cornea, or sclerotic, or the choroid, or the iris, or the retina, or, indeed, almost any part, may be inflamed. We shall treat of the common forms, conjunctivitis, corneitis, iritis, and retinitis.

Ophthalmia or conjunctivitis is a very frequent and sometimes a very severe disease in sheep. Many members of a flock become quite blind ; but though they may be quite unable to see, still very few of them will stray away and lose their companions. Usually they follow the rest of the flock by means of their power of scent, and a touching example of the friendship and kindliness of disposition of sheep for one another is afforded by the fact that " a friend generally attaches itself to the sufferer, waiting on it with the most tender assiduity, and by its bleating calling it back from danger and from going astray." (Hogg on Sheep, p. 118.) To those who believe in the doctrine of metempsychosis, the brotherly affection and solicitude which subsist among certain lower animals, and of which this illustration may be taken as an example, must in some degree alleviate the feelings of horror and apprehension which otherwise, we might imagine, they could not but feel at the idea of their individualities being at some future time possibly merged into, or, rather, identified with, that of any lower animal—it may be that of a sheep or a goat perhaps—though, it is to be hoped, not that of a sloth or a pig.

This disease is frequently traumatic in origin, at other times apparently not so. In either case there may be, and generally is, corneitis in addition.

In cases of conjunctivitis, the conjunctiva lining the eyelids is deep red in colour, and has a heightened temperature. The cornea may also be inflamed at the same time, especially when the inflammation arises from the presence of hay-seeds, or wheat-husks, or other like substances under the eyelids, or from injuries of any kind. In man the cornea is not usually affected when the conjunctiva is, though it may be sometimes. At the same time, the pulse-rate may be accelerated, the mouth hot, the appetite and the chewing of the cud impaired. The animal

is listless, avoids the light, stands apart from its fellows in the field; the closed eyelids twitch and sometimes swell, and give out a profuse discharge of tears, which become thick and viscid.

The eye itself may be exposed by placing the forefinger of the left hand firmly upon the eyebrow and pulling the skin upwards, and with it the upper eyelid, while with the right thumb the lower eyelid is drawn downwards. The separation of the eyelids gives rise to a fresh outpouring of tears. It will generally be found that the cornea, being exposed in this manner, is seen to be opaque, and of a bluish-grey colour. Should a wheat-husk or other object be observed, it may be carefully removed with the corner of a handkerchief. Sometimes a rather sharp-pointed instrument may be useful in the hands of a veterinary surgeon for the removal of the foreign body. A suitable lotion will be requisite.

The conjunctiva, a membrane covering the eye and lining the eyelids, is liable to be affected with a frequently recurring inflammation of a destructive kind, and as a result of this inflammation the eyesight may be rapidly destroyed. The lids may adhere to the eyeball, and their movements may be impeded. This kind of blindness may come on in sheep suffering from sheep-scab, and in countries wherein blindness of this character occurs frequently, the shepherds are wont to keep in their pockets a piece of hard wood, well polished, and shaped like a very small paper-knife. This instrument is introduced under the lid, when it is thought necessary so to do, perhaps at the outer angle of the eye, and by this means the adhesion is forcibly broken down. Then the eye is washed with a decoction of mallows or poppyheads, or perhaps a little oil is put in.

This disease, ophthalmia, which we are now considering, frequently assumes an epizoötic character among sheep, and sometimes also in cattle. This form of the malady is very generally known as "the blind." As a set-off against this liability to "the blind," it is to be borne in mind that sheep, and, indeed, oxen and swine also, only rarely suffer from cataract, a disorder which, in the case of the horse, is one of the most commonly met with of all the derangements of the eye. This disease, "the blind," most especially affects the young sheep of flocks kept in exposed situations. Unless the malady be arrested at an early stage, the afflicted animals sink

rapidly, and there is great risk of a fatal issue. Danger also arises from the fact that sheep, when affected with the complaint, being unable to see, may fall into ponds, rivers, or ditches, from which they have not the power of extricating themselves. The malady apparently results from exposure, whereby inflammation of the conjunctiva and the cornea is occasioned, and it is to be remarked that "the blind" more frequently occurs at the latter end of the year and after a wet season, when the grass is rich, than at other times. Possibly it may be due to a micro-organism.

With regard to the symptoms of the disorder, it may be observed that the animal suffering from it shows a great deal of weeping from one or both eyes, and that the eye or eyes cannot bear strong light. After about forty-eight hours have elapsed, the inflammation itself will be seen to be of a less marked character, and the eyes to be covered with a greyish film which completely shuts out rays of light. In fact, so devoid of the capability of seeing are the sheep, that if once they become separated from the rest of the flock, they cannot find their comrades again, except by the power of hearing. This total blindness continues for several days, until at length, if the case terminates favourably, the film which interrupts the eyesight gradually clears away, and the visual organ once more regains its normal powers.

With reference to the treatment to be adopted in the case of sheep suffering from "the blind," the first point is that the affected sheep should be taken as soon as possible to a dark shed or other sheltered place from which the light is excluded, and where the air is kept quite pure by means of good ventilation without draughts. Good nutritious food should be supplied, and a lump of rock-salt should be suitably placed in the trough from which the animals take their food. It has been recommended that a little tar should be placed around the outer margin of the eye, and that this application should be renewed after four days have elapsed. A little ointment of salicylic acid may be employed instead of tar. Again, others have recommended that a little common salt, after having been made perfectly dry by means of being heated, should be placed in a quill and then blown into the eye—*i.e.* on to the inflamed surfaces.

The most effectual treatment consists in the application of a

mixture of castor oil and corrosive sublimate in proportions dictated by the stage and severity of the affection.

When the disease is cured, and the sheep have regained their power of vision, they should be allowed to go back to the pasture; but great care should be taken not to let them get near healthy sheep, for the disease is highly infectious in nature, albeit that in the first instance it is *apparently* brought on by exposure. Moreover, sheep-farmers will, in most cases, do well to give sheep an extra allowance of food when winter is beginning to set in, and during the course of that season, since in cold weather more food is necessary in order to keep up the heat of the body, and if an additional quantity of food is suitably allowed with this view, there will probably be less predisposition on the part of sheep to catching cold, going down with "the blind," or with other diseases.

CORNEITIS.

Traumatic ophthalmia is often secondary to corneitis.

IRITIS.

When the iris is inflamed, there may be little or no inflammation of the cornea, nor, indeed, is there necessarily any affection whatever of the cornea, though there is frequently congestion of sclerotic vessels all round the margin of the cornea. The iris itself may be of a reddish yellow hue, or may present a muddy appearance. The iris cannot contract and dilate properly, as it does in the natural state of health. This incapacity is partly owing to paralysis of its muscle, and partly to the exudation from it binding it down by adhesions to the lens, and it is owing to irregularities of these adhesions that the margin of the pupillary opening may sometimes be seen to be corrugated. Inflammation of the iris may extend to the adjacent structures, and it may result in blindness.

GLAUCOMA.

There is a peculiar affection of the eye in sheep which is probably glaucoma, which leads to the organ becoming quite hard and blind. Very little good can be done, unless the disease be detected in the very earliest stages, in which case sclerotomy should be practised.

RETINITIS OR SPECIFIC OPHTHALMIA.

Retinitis or specific ophthalmia is a disorder of a much more serious nature, and it may return again and again, and bring on blindness. If the disorder manifests itself in an obstinate form, the best course is to fatten the animal, when the disorder has been alleviated or cured, with the purpose of ultimate consignment to the shambles. As we have said above, the retina is a layer of nerve-tissue which lines the interior of the eyeball. Inflammation of it may ensue as a complication of the simpler form of the inflammation of the eye.

An animal afflicted with retinitis seeks quiet and solitude, avoids the light, and closes the eyelids. In the early stages of the disease also, the pupil is contracted, the inflamed and sensitive retina not being able to bear the light. There is a profuse discharge of tears, and the animal suffers considerably in regard to its general state.

If the eyelids are separated, great pain seems to be produced, tears flow forth, the haw covers the eyeball, and it, too, is then seen to be inflamed. If the eye can be well seen, a red tinge of the fundus may be noticed.

GUTTA SERENA.

Another disease of the eye of a severe kind, and rather frequently met with in the sheep, is called gutta serena. This malady seems to be in reality due to a loss of power of the optic nerve and retina. It may, moreover, accompany either gid or apoplexy. The derangement seems to arise from the optic nerve being pressed upon, and in consequence of this pressure the retina is paralysed. Our readers will understand that this disease is more serious in nature than any lack of transparency of the eye itself can be. If there is any undue opacity of the visual organ, of course the rays of light from the exterior cannot pass through the various media so as to impinge upon the retina; but very often in such cases there may be a chance of restoring the normal transparency. Moreover, in even marked cloudiness of the media the animal can distinguish between different degrees of light, and it is capable of being fattened. On the other hand, if there is any disease of the retina itself, or of the other nervous structures concerned in vision, there is very little chance of cure.

Now in gutta serena, an affection which is also known as amaurosis, and in popular phraseology as glass-eye, there is a loss of nerve power, the retina not being capable of receiving, and the optic nerve not able to transmit, the impression of the image of an object to the brain. Nevertheless, the eye looks as clear and bright as in health. The malady consists in a loss of power on the part of the retina and the optic nerve; but the cause of the impairment of nerve-power is not well known.

A human being afflicted with this disorder is conscious of an increasing diminution of his power of vision, and an experienced and skilful oculist may be able to discover even the early changes of the retina which correspond with the beginning of the complaint. Animals also may, by the abnormal characters of their movements, show that they are losing their eyesight. For instance, in the case of a horse, shying, although in many instances it may merely indicate alarm, may be a sign of some defect of vision, and possibly in some cases at least of this particular disorder which we are considering. Again, in a very few instances, if a horse or other animal makes suddenly a movement as if startled, or markedly points its ears and moves its head towards a person approaching or an advancing object, the suspicion that something is wrong with the eyesight may be entertained.

A horse suffering from Gutta Serena will appear more than usually shy when being handled about the head. If brought to the light, he turns his head towards it; he also lifts his feet higher than is usual, and will run up against a wall if directed to it. The pupil is much dilated, round, and motionless, and the eyes are widely open, glassy, and staring. Even when the full glare of the sun, or a very strong artificial light, falls upon the eye, the pupil does not contract as in the case of a healthy horse, but remains oval (with long axis of the oval the transverse) and large.

By the aid of the ophthalmoscope, an experienced observer may be able to see the optic disc, and to note any changes which may have taken place in its appearance, more particularly in regard to colour, and to the size of the vessels which branch on its surface. If the eye of a horse is healthy, the disc when thus seen appears to be light orange in colour, and the blood-vessels are seen most distinctly on the margin of the disc. Gutta

Serena, then, is a malady of the nervous mechanism of vision, and it may result from injury or disease of the brain, or as a consequence of some derangement of the nervous system.

In conclusion, it is to be borne in mind that the disorder is probably capable of being hereditarily transmitted, and therefore that no animal which is suffering from true amaurosis ought to be used as sire or dam. The only remaining point in regard to the eye of the sheep is that, being greatly exposed, it is very liable to suffer from injuries or otherwise. In two or three cases the eye has been removed owing to its being enlarged in consequence of some new formation, and when dropsical it has been punctured.

TUMOURS, RINGWORM, AND CONCLUSION.

Tumours, sometimes of such large size as to push the eyeball out of its situation, may occasionally be seen. They have been removed, and after the removal have occasionally recurred. The best course is not infrequently to be found in fattening the animal for the butcher.

Ringworm in the region of the eyes and ears is very common. For particulars of this complaint the reader is referred to previous pages.

How infinitely important is the well-being of these two organs, the eye and the ear, to the happiness and prosperity of human beings, can perhaps be fully realised only by those who are so unfortunate as to be deprived of the use of one or other or both of these means of communication betwixt living animals on the one hand and the wonderful earth on the other in which they sojourn for a season, being then resolved into the lifeless elements which represent the end of all kinds of living things, so far as this world is concerned.

The eye and the ear are alike the most important and the most wonderful of the mechanisms whereby impressions of surrounding objects are conveyed to the brains of living animals. If we possessed useless auditory organs or defective ones, we should be unconscious, or but imperfectly conscious, of the many pleasing, weird, and thrilling sounds, which abound throughout nature; we should be unable, or only inadequately able, to hear and converse with our fellow-men; we should be shut out from one of the greatest enjoyments, the hearing of sweet tones of silvery

music, the grand harmonies of the great composers, deaf to the fascinating eloquence of the spirit-stirring orator, heedless of the ringing rhythms of the songs of poets, cut off from the brilliant melodies of musicians and of songsters.

The loss of our hearing powers would be a calamity indeed, and it is no less true that our eyes serve an equally useful purpose, and minister to delights equally impressive and equally necessary to the precision of our conceptions of Nature as a whole. Except by the aid of healthy eyes, our brains would necessarily form but very sorry pictures of the objects which abound on all sides around us. To human beings, then, the preservation of eyes and ears is one of the most necessary duties.

In regard to lower animals we cannot speak so strongly, nor can it be held to be a matter of first-rate importance that we should always take care to keep the eyes and ears of our domesticated animals in a perfectly healthy state. In the case of oxen we may not even elicit the fact that such a one or such a one is, as a juryman said he was at the close of a trial, as deaf as a post. Often there is no opportunity to find out; and even if the owner of an ox did know that his animal was hard of hearing, he is in most cases not at all likely to have curative measures employed. On the disorders of the ears of oxen it will, therefore, not be worth while to dilate.

Again, if an ox be very blind, and there is but little chance of cure without a great deal of trouble, it will often be found desirable to prepare the animal for the butcher straightway. In the case of disorders of the eye in horses, however, the wisest and best course will always be found in obtaining skilful treatment since the value of the optic organ to a horse is very great indeed.

We have very little indeed to say regarding the disorders to which the ears of sheep are liable to be subjected. In fact, they are not of great importance. Occasionally it may happen that a ferocious dog may work a greal deal of damage with the ears of sheep. Inflammation of the lining membrane of the ear may also now and again occur, and this disorder, when present, may be recognised by the animal carrying its head nearer the ground than usual, and also generally a little to one side, and by a slight occasional shake of the head. In such cases the ears

should be well washed out with warm water. Futhermore, in the summer-time the ears of the sheep sometimes get into a dreadful state if they are not attended to with great care, and sometimes it may even happen that maggots may be bred therein. Needless to relate, having once taken up their abode in this organ, they work terrible havoc, to the great agony and suffering of their victim. Compassionate shepherds should always take care that the ears of their sheep be kept as clean as possible in the hot weather.

SECTION XI.—WOUNDS, FRACTURES, SPRAINS, TUMOURS.

WOUNDS.

It will now be our endeavour to give to our readers some useful and practical hints regarding a very important and interesting subject. We propose to consider, as briefly as may be consistent with the intricacy of our topic, the more ordinary kinds of wounds and injuries which are apt to be met with from time to time among oxen, and to mention some points in reference to the treatment which should be pursued.

At times some difficulty may be experienced in deciding all at once what is the best course to be taken, and it may be said that a considerable amount of common-sense judgment is requisite in order to manage as well as possible the many different kinds of injuries with which one is liable to be confronted in cattle practice. Some one has remarked that common sense is falsely so called, because the kind of sense we understand by that term is the rarest of all kinds of sense. It has also been held that great ability merely consists in the possession of what goes by the name of common sense in an uncommon degree.

However this may be, it is at any rate unfortunately true that wounds in animals are not always well managed in accordance with easily intelligible principles. Of course difficulties are often met with. For instance, to the owner the question whether treatment or slaughter is most advisable will continually pre-

sent itself, and the veterinary attendant may undeniably now and again find room for some doubt as to his decision. Should there be, for instance, any serious loss of blood as the result of injuries to arteries or to veins ; or, again, should there be any great damage sustained by other important structures or organs, the first question which will present itself for unerring determination will be :—" Is there, or is there not, such a chance of recovery as to make it worth our while, and worth the small outlay which will be involved on the part of the owner by reason of the employment of remedial measures and the almost boundless resources of science coupled with skill—is it worth while to treat the given case or cases ? " Occasionally the responsibility may be great.

A short time ago we were, for instance, called to a case in which several oxen were badly wounded, owing to having injured and torn themselves on barbed wire fencing. Happily, a complete cure confirmed our decision in favour of treatment. In fact in most instances the answer will be, and should be, a very emphatic affirmative to the question above cited ; but of course there are cases in which we must unhesitatingly say :—" No ; it is far better for you to secure what money can be obtained than to incur the expense, even though it be but a trivial expense, which would be necessitated by careful doctoring and treatment, and then, after all, to run the risk of an unfavourable ending."

In all doubtful cases the best course, therefore, is to send for the veterinarian without the least delay, and let him decide such questions. We may be very sure that the degree of a veterinary surgeon's success, at least in country districts, will in no small measure depend upon the degree of accuracy with which he does settle such issues as these.

We mentioned barbed fencing above ; and it is well to bear in mind that, however useful this kind of fencing may be, it is still a very fruitful source of severe lacerated wounds. Oxen, like horses, are very prone to intensify the amount of injury they receive in these and similar ways by their frantic and misdirected efforts to get free. Hence, owners of stock should bear this risk in mind before deciding on the kind of fencing they use.

Innumerable kinds and degrees of injuries are, of course, met with in practice. The skin and the structures (muscles and so

on) in close relation with it, may be more or less deeply wounded, bones may be broken, internal structures and organs may be damaged, ligaments and tendons may be sprained, and finally the various joints may be actually dislocated or injured in other ways. For instance, if a wound has penetrated deeply into the three most important parts, viz. the cavities of the skull, of the abdomen, or of the chest, the most serious complications, and in many cases even death, may be anticipated.

Now, it is well to make some sort of classification of wounds, for arrangement facilitates description, even though it be at times something arbitrary. Wounds, then, may be spoken of as *incised*, as when made with a sharp, clean-cutting instrument; *lacerated*, or torn, as may result from efforts to escape from fencing or other obstacles when entangled in them; and *contused*, or bruised, as may result from heavy blows or falls. Moreover, wounds may be produced by fire-arms, and they may be poisoned, for instance, by infection or contagion, or by a snake or a mad dog.

Incised wounds are simple clean-cut sections through the skin and muscles, or other underlying structures. They may be brought about by sharp instruments of different kinds. Incised wounds, though seldom met with in cattle-practice, are dangerous when they do occur, since they are generally associated with profuse bleeding, the clean-cut vessels not being so likely to close as the roughened ends of arteries and veins that have been *torn* asunder.

Wounds are said to be lacerated when the surfaces of the wound are irregularly torn, as may result from violent blows, or contact with hooks or sharply-barbed wire, or from kicks, bites, or attacks with the horns of other cattle. Sometimes these lacerated wounds are very severe in character, but fortunately they do not as a rule bleed very much.

Now, as to the treatmeut of incised and lacerated wounds, it is first to be remarked that wounds, when small, may unite directly (first intention); but in the case of larger and more serious injuries sometimes suppuration of an extensive nature may supervene. When the bleeding is severe, measures must at once be taken to arrest it. Sometimes even the application of cold water may be sufficient for this purpose; but it is very often necessary to tie the vessels. Styptic applications, and

especially perchloride of iron, or even the hot iron, may sometimes be necessary.

If dirt or foreign matters have gained access to the wounded surfaces, these latter must be carefully cleaned by means of fomentations, the bulkier substances being removed by the aid of the fingers and forceps. If, however, a wound is clean, it is far better and wiser to abstain from washing it, since by so doing one may remove a coating of coagulated blood which has formed, and so give rise to a fresh outpouring of blood.

Union of wounded surfaces may be effected by means of sutures. The *twisted suture* may be made by passing a pin through the lips of the wound at rather close intervals, and then twisting round the pin soft twine in the form of the figure 8.

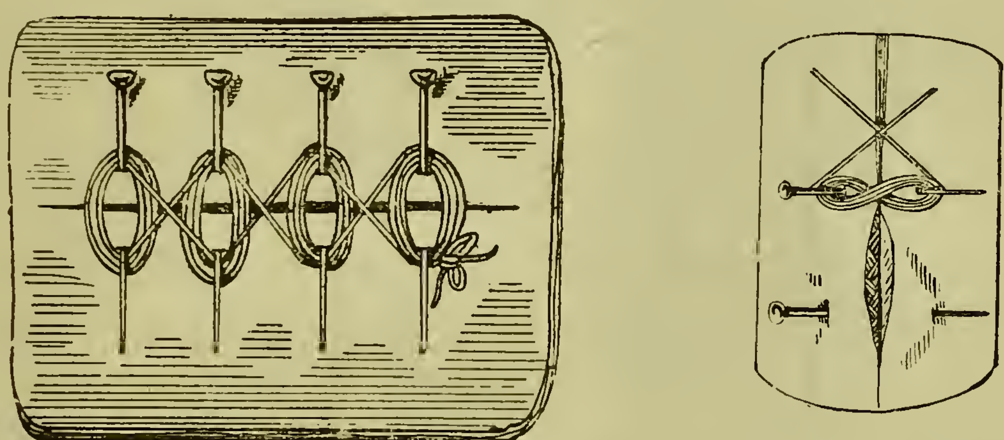


Fig. 79.—Twisted Suture.

The interrupted suture is formed by passing separate pieces of thread, or silk, or wire through the lips of the wound. In case a thread or a double and waxed piece of silk is used, the suture is tied, while if wire is employed it is twisted. The stitch should be repeated at intervals of about an inch, and it should be passed

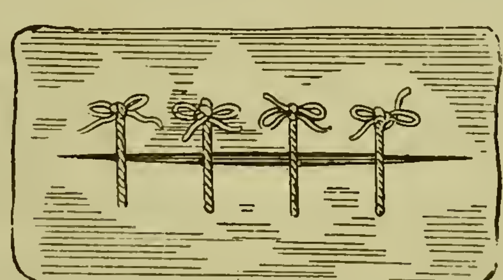


Fig. 80.—Interrupted Suture.

through the skin by a crooked needle, deep and firm hold being taken.

The uninterrupted suture is produced by passing the thread or silk continuously from one side to the opposite until the severed

surfaces are brought into close contiguity from end to end. This method is not, as a rule, a good or safe method, and should only be employed when a small and unimportant wound must be hurriedly closed.

When sewn together, wounds may be dressed with suitable antiseptic lotions. Perfect rest may be requisite, particularly when the wounds are situated in movable and important parts, and in some cases it may be necessary to place the animal in slings, in order to prevent the recumbent posture being assumed.

In the case of large wounds, and especially when they are lacerated, the many tailed bandage may often be serviceable. It

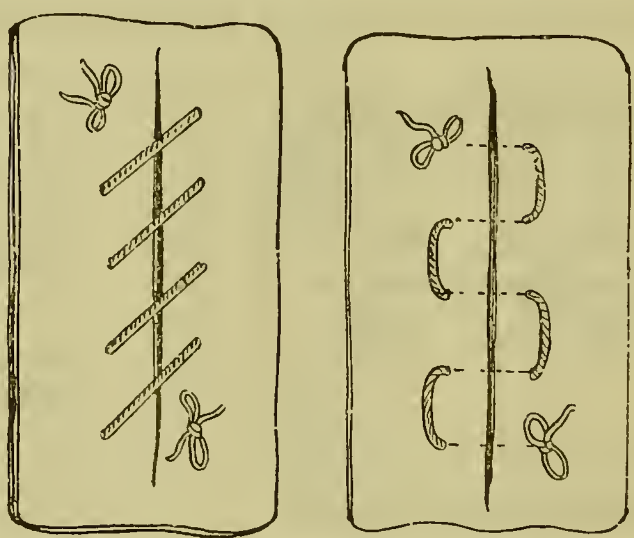


FIG. 81.—UNINTERRUPTED SUTURE.

consists of two stout pieces of canvas or other suitable strong material, each piece being glued on to the skin, from which the hair has been clipped off, at one extremity, and been slit up into tails at the other. When the glued end is firmly fixed, the tails of the two sides are tied together, and thus the edges of the wound may with care be brought into close apposition.

Quiet and light food must be enjoined in all cases of wounds, and suitable applications of an antiseptic character, such as the well-known and most valuable preparation called black-oil may sometimes be required in order to avert gangrene. Black-oil, as properly made, probably owes most of its wonderful utility to the disengagement of a little free dioxide of sulphur. It is exceedingly valuable in veterinary practice as an external application in certain cases, for instance, in sloughing and unhealthy-looking wounds, and also as an adjunct to that most valuable precaution against black-leg and other disorders, known as

setoning. Both the ointment and the lotion of boric acid, and also those of carbolic acid and other antiseptic agents, are useful for the cure of wounds. On the other hand, we cannot too strongly caution the farmer against the use of certain ill-advised preparations which not only leave undone that which they are supposed to do, but actually do most effectually that which they ought on no account to do.

In the early stages of wounds the treatment must not be active in character, but mild and soothing. Mild sedatives, such as the acetate of ammonium, also may be given or prescribed by the veterinary surgeon ; but in later stages it may often be wiser to employ stimulants, such as spirits of ammonia, or in cases where the wounds present an unhealthy appearance, rather large doses of brandy may be given with advantage. Quinine is also a valuable drug. Fomentations with warm water at a temperature of about 110 deg. or 117 deg. Fah., as shown by a thermometer, or roughly guessed at by the hand, may sometimes be useful.

Signs of general fever should receive prompt attention. The food-supply should be light and well regulated. Good sound roots, grass or clover, linseed and various kinds of grain may be supplied in small quantities. The free discharge of pus should, where it is practicable, be provided for by means of incisions or by suitable dressings. A depending orifice should always be made.

Punctured wounds are often met with among oxen as a consequence of their goring one another with their horns, and they are, of course, necessarily liable to be highly dangerous. They may also be produced by nails, by the prongs of a fork, and so on. Great skill and judgment are required, and a fatal issue, arising as a consequence of injury to internal organs, may too often ensue. The wound or wounds should be explored with great care, and all foreign material should be removed. If a muscular part has been penetrated, warm fomentations may be applied around the wound. A pledget of tow nicely formed and well soaked with the valuable preparation known and above referred to as black-oil, should be passed to the bottom of the wound, and renewed daily. It is very essential indeed that the orifice or opening of the wound should be kept open, and prevented from healing up before the inner portion has healed, and sometimes it may be necessary to enlarge it with a bistoury or small knife.

If the puncture has penetrated to the underlying bone, the best plan is to clean the wound thoroughly with a syringe and then to take a whalebone probe, wrap it round with tow soaked in a strong solution of perchloride of mercury in water, and then work the probe about in the wound, until every part has been well acted upon by that strong caustic. This salt may be obtained in fine powder, and when mixed with flour may be applied to the wound. It acts not only as a strong antiseptic, but also by uniting chemically with the albumen contained in the joint-oil. This salt is a deadly poison even in infinitesimal doses, and must, therefore, be always employed with extreme prudence and care.

The bone may sometimes decay and become loose, and the disjointed fragments should then be removed by the help of a forceps. Some recommend the use of the milder caustic, nitrate of silver; but the salt above mentioned is more efficacious. Readers must, however, remember that it is a deadly poison. The veterinary surgeon will, perhaps, sometimes use the actual cautery itself, the hot iron being applied to the wound at once, wherefrom such an amount of inflammation may ensue as will lead to its closing up. Should it be the foot which is punctured, poultices may be employed with advantage, and if pus is present, it must be got rid of. If pieces of bone are set free, they should be immediately removed, and an antiseptic lotion should be injected.

Wounds are spoken of as contused or bruised when the tissues around the wound have been much bruised, as when the wound has resulted from kicks, blows, heavy falls on the ground, or into ditches. Sloughing not unfrequently follows, and there may be internal hæmorrhage of a dangerous character. In cases of severe bruises, warm fomentations and cooling lotions may be highly serviceable.

We now have to say a very few words respecting the subject of wounds in sheep. In point of fact, wounds are to be treated on much the same lines in the case of all kinds of animals. Of necessity it cannot be a very important thing that a sheep which is badly wounded should be kept alive. In the general way, slaughter is to be recommended. Nevertheless, in certain cases it may be found advisable to treat wounds in sheep, and the great thing is to remember that bleeding must if possible be

stanched, that cleanliness is an indispensable factor in the cure, and finally that a mild antiseptic ointment, such as that of salicylic acid (so often heretofore referred to) or that of carbolic acid is of great value.

DISORDERS OF THE SKELETAL MECHANISM, TOGETHER WITH A CONCLUDING ACCOUNT OF INJURIES IN GENERAL.

We now proceed to deal with some few disorders to which the bones of oxen are liable, and we shall touch this topic somewhat lightly, since there is no occasion for us to lay great stress upon this portion of bovine medicine and surgery, as it will frequently be found advisable in cases where there is any serious bone-mischief in oxen to fatten the animals for the butcher straightway. Nevertheless, there are many simple fractures liable to be met with in practice which readily admit of wise and careful treatment, which in most instances will result in pecuniary gains.

Again, outgrowth of bone may occur in different positions, as for instance near the orbit, whence they may be easily removed by means of a suitable saw. Even when these bony growths cannot be cut off, they may very often work little or no harm. Further, if the metacarpal or the metatarsal bone be badly fractured, or if foul in the foot be very extreme, amputation of the bone itself may now and again be called for. Once more, some skilful veterinary practitioners are highly successful in reducing some dislocations. The late Mr. D. Gresswell, for instance, was an adept in this branch of practical bovine surgery, and had some really wonderful cases of this kind.

Now, inflammation of bones may come on either as a result of injury, or from such specific influences as that which goes by the name of the scrofulous diathesis. Inflammation of osseous or bony tissue causes much pain, and so great may be the disturbance and the unhealthy action that portions of the bone may gradually decay and die. Consequently, when at the bottom of a wound a bone is decaying, it is a matter of great importance to remove the disorganized portions. When bones are broken and shattered in consequence of serious injury, they may perhaps gradually die, and it is therefore necessary to remove the dead parts in such cases. When bones are inflamed, poultices should be applied, and the parts should be freely fomented and thoroughly

rested. In addition, a dose of cathartic medicine should be administered.

Now, in reference to fractures, so far as sheep are concerned, only a very few observations need be made. If a bone is broken in a sheep, the callus by means of which the separate fragments are united will be formed quickly. Indeed, it is nothing less than astonishing to observe the rapidity and the efficacy of the cures so often performed by unaided Nature in the case of all animals alike. In many cases, however, help on the part of the surgeon is absolutely necessary, if the damage is to be repaired. For instance, if we have to deal with a simple case of broken leg, the two parts should be brought into contact and kept in contiguity by means of a few splints, properly and carefully applied. After the lapse of a few days new bone will have been formed, and the fracture repaired. Sometimes, indeed, a false joint may be formed. If so, the incompletely united parts should be rubbed one against another, and the splints should be re-applied. In most cases, if this be done, fresh bone will be formed, and the union thereby rendered perfect.

As a rule, however, a sheep is not of sufficient value to make it worth while to be at much trouble in such cases, and consequently it will often be found advisable to send a sheep which has met with any serious mishap forthwith to the butcher. On the other hand, if any accident of the nature above referred to should befall any specially valuable sheep, fractures and the like injuries can in the general way easily be managed by the exercise of care and judgment, as in the case of other animals.

Instead of the bone-tissue itself being inflamed, we may be confronted with a condition in which the membrane which, so to say, clothes a bone may be inflamed, either as a result of injury, or as a consequence of the disease known as rheumatism. The membrane spoken of as the *periosteum* becomes thickened, and lymph may be deposited beneath it and subsequently become converted into bone. The name *exostosis* is given to a growth of bone from bone, and such growths often arise from inflammation of this membrane.

Again, the ox sometimes develops dense outgrowths of bone inside the skull. They grow out from the petrous portion of the bone known as the temporal bone, and extend right into the

cavity of the skull, the brain being absorbed as they proceed inwards. Sometimes these bony growths reach a great size and weigh a considerable amount. Moreover, they become moulded against the walls of the skull, and present grooves marked out on their surface for blood-vessels. Hence they are sometimes looked upon as ossified brains; but they are merely ingrowths of bone into the cavity of the skull. The strangest fact in connection with them is that as a rule they do not seem to interfere greatly with the animal's welfare, and they may be found to be present in oxen which, while living, did not appear to be very unhealthy.

Bony growths, also, as indeed we mentioned above, may occur around the margin of the orbit, and so interfere with the eye. They should be removed by the aid of a suitable saw, when it is possible; but when they grow from the ribs into the chest-cavity it is not advisable to operate. The bony growths we have been describing are called *exostoses*, because they arise from bone. The term "osteophyte" is applied to a spongy and vascular exostosis of periosteal growth. At first it is but feebly attached to the bone; but at a later stage it may become dense and firmly fixed to the bone.

We have previously described the disorder known as fragility of the bones; but in talking of bones we may mention this subject again, and also that of rickets. Now, fragility of the bones is the name given to a condition of them in which they are liable to break easily. This state of bones results from a diminution in the amount of animal constituents of the bone tissue, or from an excess of the earthy material, which last in either case preponderates so much as to render the bones brittle. The disease is in fact due to atrophy of the bone, the animal constituents being, relatively to the inorganic constituents, very largely increased. The disorder is sometimes known under the appellation of *cripple*, and it affects oxen, and especially milch-cows, in certain localities.

It may either be occasioned by a deficiency of phosphates in the food, or by the fact that they are secreted in too great quantity by the medium of the milk, or to some other cause of debility. Further, the lack of phosphates in the food may spring from a want of these salts in the soil, and this in its turn may result from that grave evil, over-stocking the land, from which

ill-advised course damage and loss must necessarily accrue to the farmer and to the landowner. When suffering from this malady, the ox staggers, cannot rise from a recumbent posture, or can do so only with the utmost difficulty; the bones swell, especially near and at the joints, and the animal becomes paralysed. A mild laxative, a full and nourishing diet, mineral tonics, and phosphate of calcium may be tried.

If an animal that has died when afflicted with this disorder be examined after death, ligaments may be seen torn away from their places of attachment, while the bones are seen to be enlarged, friable, broken, and with bony outgrowths upon them.

Rickets is a disease in which the nutrition of the body generally is perverted, one result of the disordered condition being irregularity of ossification, with resulting softness of the bones. This disorder often occurs in calves of about a few weeks old, and it is shown by enlargement of joints and a bending of the limbs, especially below the knee and the hock, as the case may be. As a rule the malady is accompanied by indigestion and diarrhœa, and it may be due to an imperfect supply of milk. The patient must be nursed carefully, and must be supplied with nutritious and easily digestible food, cod-liver oil, lime-water and tonics, and other medicines given in milk. Those portions of limbs which are bent may be supported artificially and partly straightened by splints.

FRACTURES.

When a bone is merely snapped asunder so as to be simply broken into two or more pieces, the fracture is spoken of as *simple*; when the bone is shattered and separate fragments are produced, the fracture is said to be *comminuted*; when the skin also is torn and the bone projects through the orifice produced and makes its appearance externally, the fracture is called *compound*. In fact, when all the structures superficial to the bone, skin included, are rent, the fracture is spoken of as being *compound*. When the bone is broken into two pieces, the fracture is called *single*.

A fracture of a leg-bone gives rise to a sudden and intense lameness, and usually to a loss of power to move that part of the limb which is below the injury, while near the fracture itself the limb may swell and become hot. If we take hold of the limb

both above and below the seat of a fracture, and gently twist the two parts in opposite directions, a grating sound may be heard, and a grating will be felt.

In regard to the management of fractures occurring in beasts, it may first be said that it is by no means always wise to treat them. The chief difficulty arises from the fact that in the case of lower animals generally, and especially in that of oxen, it is a matter of considerable difficulty to keep the animal in one position. That useful contrivance known as slinging, so valuable in the case of horses, is not easily applicable to oxen, whose complex digestive apparatus is so liable to be compressed by slinging, and therefore greatly interfered with in regard to its activity.

Young oxen which are accustomed to fighting are very likely to break their horns. The bleeding hence arising may be profuse, and must be stopped by pressure or by the actual cautery. The orifice into the frontal sinuses should be covered with a tarred cloth, bound not closely but firmly. Mr. John Henry Steel, F.R.C.V.S., an eminent authority, states that experience among Indian cattle shows that spiral fracture of the humerus and fracture of the neck of the femur are frequent in India. Fractures in young animals unite more readily than in the adult.

Suppose we have to deal with a limb broken below the knee or hock. We shall require two gutta-percha splints, about two-and-a-half inches wide, and long enough to reach from the knee or hock, as the case may be, to the coronets. These splints must first be softened by being placed in warm water. Then the two ends of the bone should be brought into exact contact, the splints should be moulded to the limb with the hand, and then a bandage should be carefully and rather tightly rolled round and round the splints so as to keep them fixed in their position. Should they, after all, become displaced, they must be readjusted.

Starch bandages also are very useful, starch being nearly always ready to hand during an emergency. The starch should be mixed with a sufficiency of warm water so as to be thick, and the bandage, which must be about half-a-foot broad and about four yards in length, should then be well soaked in it. As the bandage is being applied, an assistant should be at

hand to add a rather thick layer of starch at each turn. If the larger bones, such as those of the thigh, pelvis, or fore-arm, be broken, then the best course is, in most instances, to consign the animal to the slaughter-house.

SPRAINS.

Sprains usually occur in connection with the fetlock-joint, and the back sinew of the leg may also be the seat of lameness due to sprain. The sheath of this tendon may have some of its fibres ruptured, or some of the smaller ligaments binding some of the bones of the fetlock together may be more or less injured. The animal is lame, the parts are hot and swollen, and pressure on them causes the animal to shrink. Sprains may be treated with fomentation and cooling lotions, and when the inflammation is subdued a stimulant application may then be used; but it should be very carefully borne in mind that it is a very great mistake to apply stimulating embrocations to parts which are actually inflamed. Cooling lotions, *e.g.* of lead and spirit and water (1 fluid ounce of Liq. Plumbi Acet., 1 fluid ounce of methylated spirit, 6 fluid ounces of water), may be very useful.

It often happens that oxen are lame in the stifle. If there be no inflammation, the compound liniment of ammonia should be well rubbed over the joint once or twice a day. Setons inserted over the joint and dressed with black oil daily are also to be recommended. They should be inserted every fortnight, and the parts should be kept quite clean.

Our readers will see that many different kinds and degrees of injuries are met with in all animals, and that in regard to oxen most especially it is often the case that the alternatives of slaughter on the one hand or of treatment on the other present themselves for consideration. In the horse this point is far less seldom raised, since the value of a living horse is great, while that of a dead one is trivial.

Now, speaking of injuries generally, we see that there may be dislocations, or other derangements of joints, more or less serious fractures, and also more or less severe wounds. Wounds, too, may be of divers kinds, and the dangers arising from them may also be of different natures. There may be great, or even excessive, loss of blood, owing to the opening of important arteries

or veins. Of course, if this is not speedily checked, a fatal issue is certain to occur, and hence in such cases the blood-vessels should, if possible, be carefully tied, both above and below the seat of injury.

Again, damage may be done to other important structures or organs—the bowels for instance, or the lungs, or the brain, or possibly the heart, or some important muscles or sets of muscles. So great indeed may be the disturbance produced that death may result from the derangements brought about. Even in the case of less serious wounds, unfavourable complications may arise. The wound, instead of progressing favourably, may take an unhealthy turn. For instance, sometimes the external jugular vein, after blood has been removed from it in the usual way, may become inflamed. If so, the best course is to take out the pin, to foment the inflamed place, and then to apply an active blister along the whole course of the vein.

The great value of antiseptic measures and also the importance of good methods of closing up the wounds are to be noted ; for it is to be remembered that the parts affected by a wound, if left exposed to the air, are liable to go on badly. On the other hand, however, in the case of punctured wounds we must be on our guard lest they heal up superficially too soon, and leave a festering sore inside which would necessarily be very dangerous.

If our readers will kindly give these points their careful attention they will clearly see that a great deal of judgment is requisite in regard to the treatment of the many different kinds of injuries and wounds among cattle, and we may also add that special knowledge is necessary in reference to the internal treatment used to facilitate recovery; and, finally, that it is nothing less than astonishing to observe the wonderful cures that may be made by those who really endeavour to combine the resources of science with trained skill and careful attention to detail.

TUMOURS.

The abnormal growths in oxen and in horses bear a much closer resemblance to, and throw a much brighter light upon, those of human kind than is as yet indeed even dimly realised. It would, however, in this place be untimely to dilate upon this most fertile, this most intensely interesting of subjects, deeply

and wonderfully important as it is. Those of our readers, however, who can form any conception of the incalculable suffering caused by those all-too-common tumours—the cancers—in man will in some way grasp the importance of the relationship between the tumours of the domesticated animals and those of human beings; and, indeed, the same is true in regard to the importance of the relationship of the other diseases of man and animals.

This science, that is this science of the relationship of the diseases, goes by the name of Comparative Pathology; and it is indeed a great science, for most certainly the intense importance of our lives has a much wider and a far deeper basis, a more far-reaching significance than may at first sight be generally seen. Yet, though we cling to life with all the power of our most determined will, we are very apt indeed to cling to it in wrong and unwise ways, and there is no one—however great he be—who does not at times do well to re-consider from an entirely new standpoint his position as a living unit in this world of animate existence. There is indeed no one who does not at times do well to study the laws of hygiene, and the necessity for preserving a healthy mind in a healthy body, and the great purpose and object for which he was born into this world.

In these pages we have indicated the relationship of the diseases termed *tuberculosis*, *scarlet fever*, *anthrax*, *actinomycosis*, and many others of oxen, with the same diseases in man. And similarly there is a relationship between the tumours of man and animals. Yet in these pages we must restrict our remarks to the subject under immediate consideration, and leave its side issues for those especially interested.

Varieties of Tumours.

The ordinary epidermal growths from the skin, the angleberries, are very commonly met with in oxen, and they are very similar to those of horses. They occur, as a rule, in small numbers, and usually grow on the inside of the thigh and on the legs, just as in horses. The removal of these growths presents no difficulty, as a rule, but in most instances surgical treatment is not called for.

A second kind of epidermal growth like warts varies in size from a pea to a man's fist. It may occur in almost any part of

the body, on the face and head, teats, nose, or other parts. Sometimes these growths are firmly adherent by a large base; at other times they are very easily removable, having in such instances only a small base. In some instances they may be pulled off by the hand only, and sometimes they require for their removal the clam and actual cautery. In these latter cases the clam is fixed round the tumour at its base, and then the tumour is burnt off. Any bland or soothing ointment, or black oil, is useful as an after-dressing. Sometimes, being very diffuse, they are very difficult to remove, and it is necessary to take off the skin with them; but they never penetrate into the tissues beneath the skin. Some, we may point out, are loose and hang pendulously, while others are spread out diffusely and grow into the skin. Mr. J. Brodie Gresswell often operates on several beasts in a herd, and takes off hundreds and hundreds of these tumours in the course of each year. In colour the section resembles that of a raw potato, and sometimes in appearance the tumour may be compared to an onion. In other instances the growth appears like a cauliflower excrescence.

A third kind of tumour is made up of a highly vascular material, and is generally found in well-bred beasts. These tumours are about the same colour as the membrane from which they grow, and the superficial surface is reddish and has the appearance as if about to bleed. They may be about the size of a couple of walnuts, and may be compared in general colour to a small rose, being also diffuse and spread out at the surface. These tumours are removable with the clam and actual cautery. They appear in the rectum and elsewhere.

A fourth kind of tumour, a kind of so-called *papillomatous* growth, appears on the penis of bulls. These are filiform growths and are not very easily removable, but with a little skill and care the removal of them presents no difficulty. In a case where a *cancer* occurred in this part in a bull, slaughter of the animal was decided upon as being preferable to treatment in this instance.

Of cancerous tumours, which are the fifth variety, we shall not have more to say.

Fatty tumours are the sixth kind. They are commonly seen in the neighbourhood of the shoulder, and often weigh two to three stones. These growths should be taken off with the knife

in the earlier stages; but if they have gradually grown to a large size, it is often best to slaughter the animal.

The seventh variety of tumours in oxen, of which we shall speak here, are termed wens. A true wen is a dense fibrous tumour with a small core of cheesy or calcareous material. Indeed a wen may be compared with a purse, with sides of fatty and fibrous tissue, and a small cavity. Wens vary greatly in size; they may be as large as two fists, and they generally appear either under the tongue or at the angle of the jaw or near the throat. In some instances in the earlier stages a strong blister of biniodide of mercury will remove them altogether; but, when full grown, they can only be taken off with the knife. They may possibly be tuberculous in origin and nature. True wens are to be distinguished from cartilaginous thickenings or tumours of the larynx or throat, which may be rather diffuse and flattened, and are firmly adherent to the larynx. Our readers will perceive that tumours are much more commonly met with in oxen than in horses; and the importance of this fact is one not to be overlooked, bearing as it does on the relationship of the tumours of man and beast.

The eighth and last kind of tumours in oxen are termed *osteo-sarcomata.* They are not uncommon on the lower jaw, beginning as hard bony swellings and gradually enlarging. As they grow, the skin sloughs from over them, and the growth then presents a raw surface, from which a horribly fetid discharge oozes. If the animal is allowed to live, these tumours grow to an enormous size, and, strange to say, their presence does not seem to affect very materially the general health, until they involve the alveolar cavities of the teeth and the tongue. The animal, unless killed, then wastes and dies.

In cases of *osteo-sarcomata*, the best plan is to have the animal slaughtered, as these tumours always involve bone. In shape these growths are usually oval, and they are about four to eight or ten inches in length as a rule. They spread into the bone of the jaw, and in weight they vary from two to eight pounds. On the surface they are greatly cut up and nicked. Of such tumours the writers have seen twelve or fourteen. These tumours, we must mention, are to be distinguished from the exostoses mentioned in our last. Our readers are no doubt aware that a beast

may have a long bony growth on the jaw or elsewhere merely as the result of an injury or so forth.

A short time ago a small tumour, an epulis, weighing about one and a half ounces, was excised by Mr. J. Brodie Gresswell from a beast's gum on the inside of the mouth. The tumour was situated at about the position of the first molar tooth on the lower jaw. A little tincture of myrrh was used as an after-dressing. The beast made a complete recovery, though it suffered much during the removal. The animal was a feeding bullock, and the tumour had caused continual slavering and interfered with the feeding.

We may here add that the use of the écraseur, of which an illustration is shown below, may be advisable for the removal of certain tumours.

We do not intend to continue our description further, as we have already in a previous article discussed the causes, nature, symptoms, and treatment of the tumours so commonly found

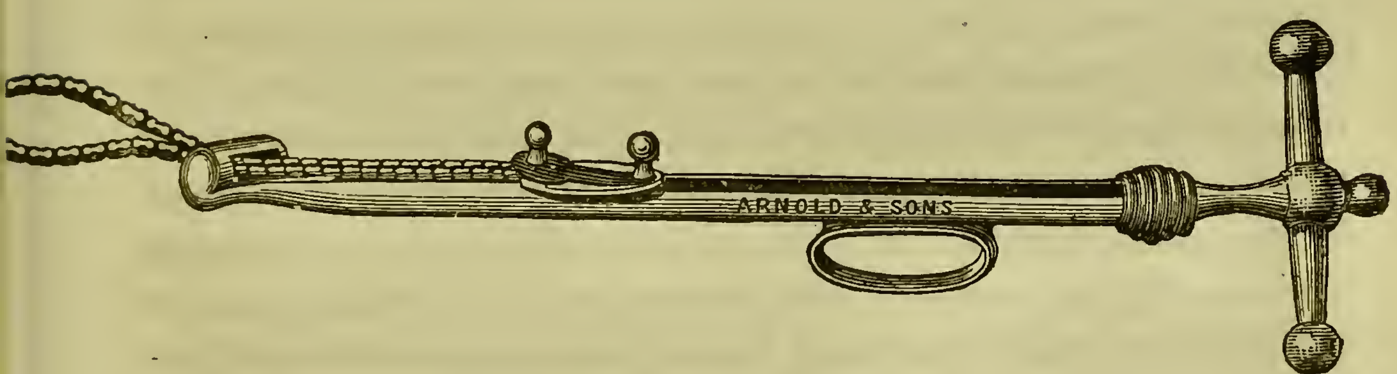


Fig. 82.—An Ecraseur.

imbedded in the tongues of beasts. These tumours are caused by the growth of a fungus termed the *actinomyces,* or ray fungus, and the disease itself is termed *actinomycosis.*

Before concluding, we should point out that the chief importance of a study of comparative pathology lies in the fact that in deep and careful observation of disease lies the secret of the prevention and treatment of morbid conditions. The organic world exhibits alternating periods of action and rest in obedience to an external rhythm, and there is evidence to prove—abundant evidence to prove—that hygiene and therapeutics must be directed with attention to these rhythms. There is evidence enough already furnished to show that the principles of Charles Darwin and Herbert Spencer explain in degree some, and possibly

should explain most, abnormal as well as normal manifestations of life. These principles should lie at the foundation of rational biology, morphological and physiological, whether regular or irregular, normal or abnormal.

SECTION XII.—THE REPRODUCTIVE SYSTEM AND THE DISORDERS CONNECTED THEREWITH.

THE REPRODUCTION OF THE SPECIES (A).

During the gradual origin of the universe and its contents from the chaotic confusion of bygone æons a differentiation has arisen betwixt living and non-living things. Of all the many distinctions we are in the habit of drawing, when we pause to look around us and to take a sweeping survey of the innumerable objects contained in the world in which we live and move and have our being, by far the deepest and the most important is that which subsists betwixt animate and inanimate things. Yet though these two widely separated groups, into which everything which exists upon this earth can be arranged, are characterised by the most essential and deep-lying differences, nevertheless when we try to formulate and make clear to ourselves and to the minds of others the broad line of demarcation which apparently separates the lowest of living things from inanimate material, we are obliged to humble ourselves to the extent of saying that we cannot do it, and that this broad line gets narrower and still more narrow, the more deeply we peer into the previously hidden aggregates of organisms opened to our gaze by the modern microscopic methods.

Moreover, it is far from being an easy task to frame an exact or even a good and fairly workable definition of what is really implied by the term life, and there are very many who would hesitate to accept the idea that the life of a human being is in all essential respects to be compared with the life of an animal. Despite all the reiterated teachings of the materialistic school of science and of thought, there probably never was a time in the history of the world when so many of the foremost men of the day hold with no unsteady faith the belief that we human beings

are not merely made of clay which is animated for a short time, and then crumbles into the dust wherefrom it arose, but that we, howsoever humble and insignificant, have yet a great future before us, a far higher form of existence than this present comparatively speaking trivial one. This unswerving acceptation of the widest of all truths is by no means weakened by the fact that, as indeed has been suggested by no less an authority than Mr. Herbert Spencer, even the very best ultimate definitions of life which can be put into words apply to the wondrous phenomena presented by the solar system as a whole, and we might add to those of nearly all complex aggregates such as the earth itself, perhaps only a little less accurately than they do to living beings.

However, notwithstanding that this is true, it remains incontestable that the classification into living things on the one side and inanimate objects on the other is at once the most significant and the most indispensable of all the distinctions which men, as a matter of fact, do draw. Yet we have been led to the idea that the lowest living things rather support the view that in ages long gone by even living matter itself may possibly have originated by insensible steps from inanimate material, and that by degrees this life may have become more and more complex until, according to an ordained law of advancement, even human beings were at length evolved. Yet it is clear that this is by no means an entirely satisfactory conclusion, and to those who think most deeply on the great question of life and its meaning, it cannot but be manifest that there must be some explanation of our presence here in this world which has not yet been grasped. At times, and frequently when we are quite alone, the conviction will force itself irresistibly upon our minds that, though we can in a large measure explain the actual steps and processes whereby we human beings are daily and hourly brought into this sphere, still there remains a much larger and more far-reaching truth than any as yet arrived at by the mind of man.

Of all the magnificent sights which may be seen around us, the view of a storm-tossed sea is perhaps the most impressive. In absolute solitude to walk along the sea-shore, and listen to the solemn voice of the mighty ocean, to hear the majestic tones of the loud and triumphant pæan, as the crashing waves roll and thunder with infuriated yet moderated harmony, and

toss and tear onwards towards us on the sand-covered beach, is indeed a thrilling experience. The grand tones ring through the ears like deafening peals of resounding bells, the myriad stars supply the heavens with minute specks of twinkling light, insignificant enough when compared with that shed upon the glistening sea and sand and sand-hills with silvery effulgence by the calm and majestic luminary, queen of the splendid night, sovereign of the sky and of the broad expanse of the tempestuous ocean, as far as where the eye can discern the darkened limit of the horizon. Heavy black clouds, too, speed hurriedly across the sky, now and again hanging overhead, and blocking out the soft and silvery light falling down from the moon. In the glimmering distance rocky crags, symbols of destruction, stand out in the background, ready to devour the unmanageable ships, threatening to drive back the trusting mariners to sudden death. Truly the sight is well suited to the powerful chorus sung by the broken surface of the sea, lashed as it is into the fury of madness by the uproarious and frantic turbulence of the groaning winds.

And we who see and hear in silence and in wonder are merely mechanisms manifesting vitality and evolved by chance! Human beings, here to day; alas! to-morrow in the grave; transient and ephemeral links in the chain leading upwards to a hollow mockery of perfection on this earth, which is, and always has been, and always will be, coming, and yet is always afar off in the dark distance. No! the powers of the most ordinary intelligence should, we think, be keen enough to probe more deeply beneath the surface of the world around us, and to let us know assuredly that there are things far higher than we can ever realise, so long as we remain on this, the hither side of the great gulf which yawns as yet betwixt us and eternity.

If we admit this, and recognise how surely our bodies must ere long be turned into the lifeless clay, from which men first did spring, even as ashes are committed to ashes and dust unto dust, how much less would all our little troubles seem, and how little should we forget that the links which bind even the strongest of us here are, after all, only weak and slender threads. If, then, this insolvable problem of life at times thus presents itself to our minds in all its weird intensity, we shall be the more ready carefully to consider the conditions which underlie the beginnings

and the preservation of life. We shall ever be on the alert to find and to trace them, and then to strive with all the powers of our minds to comply with their reiterated and most definite injunctions.

Now, the aspects from which life can be regarded are many and various ; but one of the most instructive questions which are to be decided is that to the consideration of which, after this introduction or digression, we now come. It is, "How do the different living things upon this earth reproduce themselves?" That all living beings do, almost without exception, in the ordinary state of healthful activity, reproduce their kind, is one of the main points whereby they are characterised. By means of this function each race is continued on in its existence from generation to generation, until, in the lapse of ages, it is either gradually developed and transformed into a successively more and more highly endowed race, or, on the contrary, is perchance rendered less and less able to exist under the new, and changed, and ever changing, conditions, to which it is subjected.

It has been shown that some kinds of organisms may be, so to say, stamped out by reason of the inexorable course of that incessant and interminable struggle for existence, whereby, as we cannot but hope, the highest possible perfection will in the far distant future be reached. In this connection it is to be borne in mind that the same far-off result can, in so far as animals are concerned, be in no small degree anticipated by the judicious selection and management of the best and healthiest stock on the part of the agriculturist, who may thus, by the long-continued exercise of great care and judgment, gradually but yet most surely improve his breeds of domesticated animals to a truly wonderful extent, as indeed has been repeatedly and most abundantly proved.

If it is true, as we have alleged it is, that great difficulty may be experienced in clearly damarcating in words the lowest members of the animate kingdom from the more complex of the aggregates occurring in the inanimate world, it is also most noteworthy that difficulties of a like nature present themselves in regard to marking off the many divisions made betwixt different groups of living things themselves. Searching down among the simplest living organisms by the aid of the strongest magnifying powers of the microscope, we find that no constant

line of demarcation can be drawn betwixt animals on the one hand and plants on the other. In short, the lowest living things cannot be said to belong either to the one great kingdom or to the other; but, as we gradually ascend the scale of life, we can discern the successive steps by which the line of division becomes more and more distinctly clear.

Now, this statement holds with regard to all the processes of life, to the means whereby offspring are produced, no less than in reference to other functions and other features. In the more lowly developed organisms the process of reproduction is a very simple one indeed, consisting as it does merely in the splitting of the parent into two distinct portions, or in the budding off of a small offshoot which gradually grows and grows into the form, shape, and size of the parent. On the other hand, it is remarkable how different is the process of reproduction in higher animals from that which obtains in higher plants.

In the most lowly developed organisms, as we have just said, the process of reproduction is, comparatively speaking, very simple. It may be well, however, to observe here that we have in all probability much yet to learn of the life history of the lowest forms of organisms. It was until recently supposed that reproduction among them was confined to the mere splitting of the parent into two distinct portions, or to the budding off of a small offshoot which gradually acquired the characters of the parent. That this is not the whole matter, is clear as regards the three saprophytic parasites whose life-histories have been so admirably elaborated by the Rev. Dr. Dallinger. These monads, after giving birth to many generations by the simple process of fission, enter upon an amoeba-stage in which sexual congress is necessary for further multiplication. And we may well hesitate before we subscribe to the belief that sexual congress is not an essential from time to time in the life history of others of the lowly forms of life in which as yet only multiplication by fission has been observed. Still it is remarkable to note the increasing complexity of the process of reproduction as we ascend the scale of living things.

Under the ordinary circumstances and conditions of life, each living being gives rise to the production of another being, which gradually becomes more and more like itself; and if we note by the aid of the microscope how, even in the case of the minutest

creatures, like generally gives origin to like, whether it be plant or whether it be animal, we see in miniature and on a very small scale an exemplification of a wide and far-reaching truth. In accordance with this law of reproduction, the great and wondrously complex world of living organisms, of which huge pyramid, so to speak, we human beings form as it were the highest point or apex, continues to maintain its rhythmically interrupted existence from era to era of the world's history, from æon to æon.

We have said that the lowest living things reproduce their kind for many successive generations by simply splitting up into two or more portions, each of which assumes an independent existence forthwith, and that this is true in regard to both animals and plants of very low type. As we gradually advance, so to say, up the ladder made up by the innumerable forms of life, we see that instead of actual division or fission, the process of budding or gemmation above mentioned becomes more and more distinctly marked, while coincidently a differentiation betwixt the two sexes occurs. Then, as we ascend the scale of existence, and especially that of animal life, we find the processes of fission and gemmation become less and less frequent, and the two sexes gradually becoming more and more differentiated from each other, neither of them multiplying by fission or by gemmation, and one sex definitely supplying the ovum or egg, the other definitely furnishing the sperm cells whereby the egg is fertilised.

Ascending still higher the tree of animal life, we are successively confronted with new and more complex factors, until in the highest animals, the mammals, the functions of reproduction of their kind is one of most serious and grave moment, and apparently often of such great importance as to override nearly all other considerations. In the female a special cavity is formed, and set apart for the developing fœtus. Herein the fœtus is contained, and it is supplied with nourishment from the mother, until sufficient strength has been gained to enable it to fight its own way in the world by the aid of the help still supplied by its parents. It is then expelled from the mother's womb, but by no means is it yet left entirely to its own unaided resources. On the contrary, the new-born creature, thus unwittingly introduced into this marvellous world of ours, is

tended and cherished with fondest maternal care; and being a member of the class mammalia, it is fed with an important and highly nutritious fluid, milk secreted by a special organ, known as the breast or mammary gland.

Thus the young animal is in the general way dependent for some considerable period upon its mother for care, for nourishment, and for warmth. Moreover, so wisely are the laws of nature made, so beneficently are necessary connections of this kind rendered agreeable ones, that the supply of what is requisite for the safety of the offspring it is one of the highest pleasures to the maternal parent to afford. There are to this rule, as to others, exceptions; but its almost universal truth among mankind and animals alike is indisputable. In the case of human beings this dependence of the young upon the parents is carried on until a much later period of life, and to a much greater and wider extent. When we, men and women, think of what our parents have done for us, we cannot but find it our highest pleasure always to cherish them in their old age, or their memory, if they have left us, in humble thankfulness, full well knowing that, but for them and their long-continued fostering care, we would not even have preserved our lives, far less done any good work in the world.

Having now briefly sketched some of the general aspects of reproduction, we will now give the periods of gestation, and at the same time, also, the average number of respirations, of pulse-beats, and the normal temperature in different domesticated animals :—

Period of Gestation.		Respirations.		Pulse.	Temperature.
Mare ...	... 340 days.	Horse	9	36	99° F.
Cow ...	... 280 ,,	Ox	15 to 50	55	101° F.
Sheep and goat	150 ,,	Sheep	30 to 200	75	102½° F.
Pig ...	... 120 ,,	Pig	15 to 25		103½° F.
Dog ...	... 63 ,,	Dog			100½° F.
Cat ...	... 55 ,,				
Rabbit	... 30 ,,				

The periods of gestation vary with individuals and with breeds, with the sex of the offspring, the age, strength, and condition of the mother.

We now proceed to consider some of those rather too numerous adverse conditions which are liable to be met with

when the cow is about to expel the fœtus from the womb, and in doing so we shall learn that it oftentimes happens that just a little assistance of the right kind is sufficient to aid the efforts made to perform this act, the most important, arduous, and dangerous of all nature's operations. It is, indeed, to be expected that great and grave difficulties should attend upon the act of parturition ; but great as they are, they can fortunately often be easily obviated. In very many cases where obstacles to the act of expulsion are met with, the assistance of a good practitioner will bring about a saving of the life of both the parent and the offspring. Yet it is to be borne in mind that, though simple when thoroughly understood, still there is not one of the processes of life which is so apt to puzzle and confuse the inexperienced so much as this one with which we are about to deal.

The subject we are now in due course dealing with is one which, at first sight, is apt to appear exceedingly intricate. Indeed, the topic seems to present such difficulties as almost to deter many people from really trying to comprehend it. Nevertheless, it is one of great importance, and if we succeed therefore, in clearing away some few of the cobwebs which cluster around it, we shall be quite satisfied with the result of our efforts.

Still, we cannot but feel a little afraid that we may not succeed so well as we should like to do in our attempt to set forth the phenomena of reproduction in the case of the cow, so that our readers may readily and easily understand what we say. We shall, however, proceed to do our best in order to clear away some of the obstacles which present themselves, and we hope that our indulgent readers will excuse any shortcomings we may display, resting satisfied if they are enabled to gather up some valuable hints here and there, although they may not follow us in every observation we make.

Indeed, the act of parturition is in reality, when clearly grasped, a very simple and a very interesting one ; but it is too often looked at from a vague and confused point of view which leads to all kinds of most absurd and even fatal mistakes in practice. This statement applies not only to cattle, but also to nearly all living beings which require and receive help in that most important of all nature's operations.

Some of the following remarks, and also the pictures, are taken by permission from "A Lecture on the Anatomy and Physiology of the Maternal Organs of Reproduction in Animals, with the Principles of Practice applicable to Cases of Difficult and Preternatural Labour, more especially in the Cow and Ewe," by James Beart Simonds, late Principal and Lecturer on Cattle Pathology of the Royal Veterinary College.

The cavity of the pelvis is enclosed by the bones constituting the hips and buttocks (*vide* figure appended below), and it is to be borne in mind that the size of this cavity is materially connected both with the rapidity and with the safety of the act of parturition.

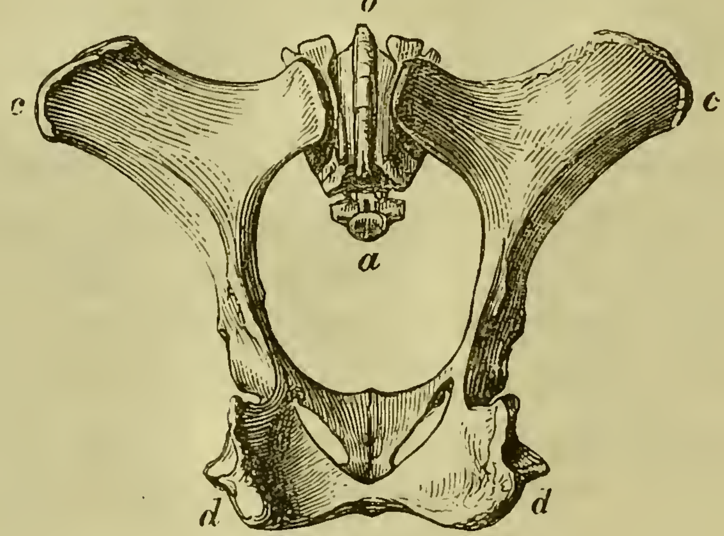


FIG. 83.

The above figure well shows the pelvic cavity of a cow, and the bones which bound it, their relative connection with each other, and the way in which they form the opening through which the fœtus passes in delivery.

a. The pelvic cavity. *b.* The sacrum, a continuation of the spine. *c, c.* The projections, called the hips. *d, d.* The bony prominences of the buttocks.

Many an animal has been lost owing to its pelvis being too narrow to allow of an easy and safe delivery. Hence the practical breeder should always bear in mind that, when the hips are narrow, the buttocks compressed together, and the spine drooping, the size of the pelvic cavity must be small, and parturition thereby rendered more dangerous.

In the first place we must say a few words in reference to the organs and structures concerned in the process of generation in the cow. These, as in the case of most higher animals, consist of the vagina, the uterus and Fallopian tubes, and the ovaries, together with their several appendages. The vagina is a tube or canal leading from the exterior to the uterus. It is a mem-

branous tube (*i* in the figure appended below) extending from the labia pudendi to the mouth of the womb (*b*), and it is situated at the lower part of the pelvis, below the rectum. On its lower surface is the orifice (*h*) of the urinary bladder (*g*). Shortly before the act of parturition, the walls of the vagina become flaccid, and bedewed internally with a copious mucous secretion, whereby the delivery of the fœtus is rendered more easy. During the act of coition the intromittent organ of the male is placed within the vagina, and comes into contact with the mouth of the womb, whereby the seminal fluid is transmitted into that cavity. The uterus of an unimpregnated animal is small, and especially of diminutive size in the case of a virgin animal, *i.e.* as compared with a cow which has given birth to several calves. Moreover, the unimpregnated uterus is, for the most part, lodged within the cavity of the pelvis; but when impregnated it extends in some degree into the abdomen. On each side the uterus is prolonged into a branch called a horn, which, in its turn, is continuous with a tube called the Fallopian tube, near the fimbriated extremity of which is the important organ known as thê ovary. From each ovary the ova are passed along the Fallopian tubes into the uterus.

The uterus or womb, *a*, is kept in its situation chiefly by means of the broad ligaments *f*, *f*; at its anterior part its coats are continuous with the vagina, and posteriorly it is divided into two horns, *c*, *c*, to the extremities of which the Fallopian tubes *d*, *d*, are attached, and the ovaries, *e*, *e*, are connected with these Fallopian tubes.

During the period of gestation, the os uteri, or mouth of the womb, remains closed; but at the time of parturition it is widely dilated, and thus allows a free and open passage from the vagina to the interior of the uterus. The coats of the uterus are three in number, and united to each other by connective tissue. The external or serous coat is smooth and continuous with the lining membrane of the abdomen. This coat gives support to the uterus, and being reflected on each side forms the two broad ligaments. The middle or muscular coat varies considerably in strength and thickness, according as the uterus is or is not impregnated, being in the latter case thin and weak, and in the former becoming greatly increased during gestation.

As the reader will readily understand, the expulsion of the

fœtus from the uterus partly depends on the suitable contraction of this muscular coat. The internal or mucous coat presents a velvety appearance, and it secretes the menstrual fluid. The principal function which it subserves is the forming of a bond of connection between the mother and her young ones, whereby their vitality is preserved and their development brought about.

A section of the wall of the uterus, when examined with a microscope, may be seen to be composed of three distinct coats

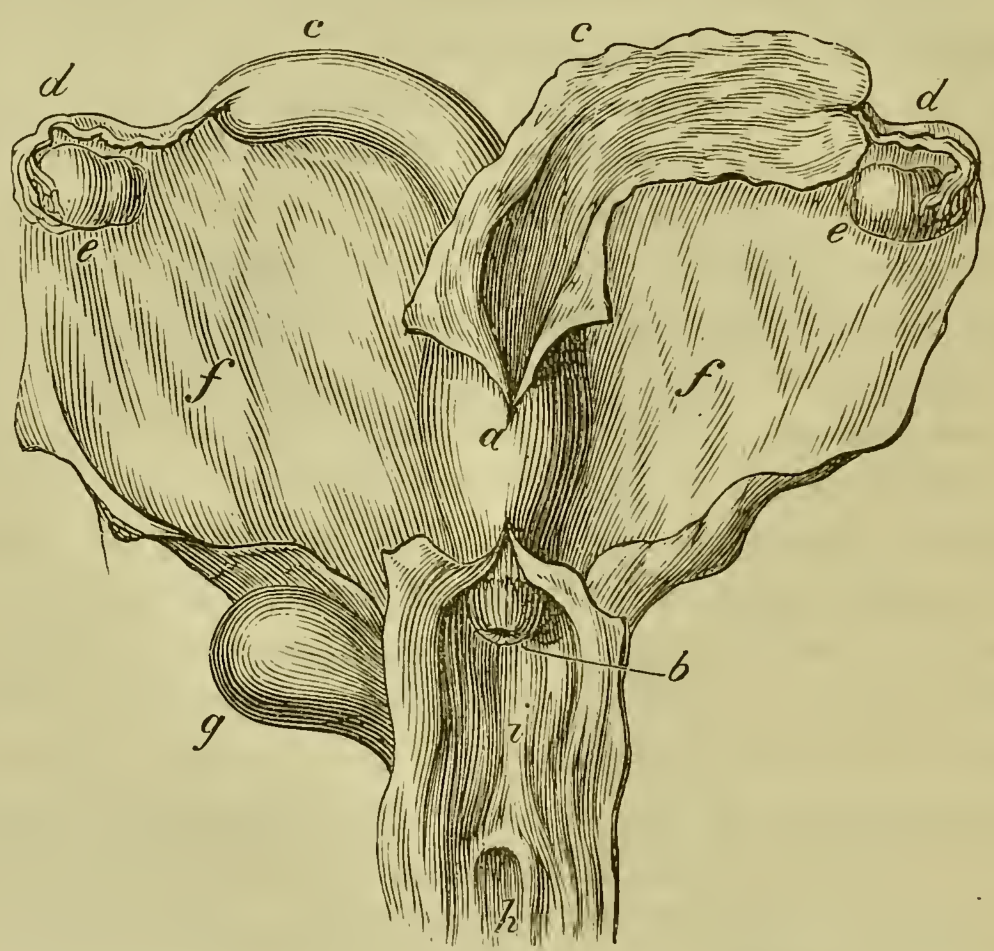


FIG. 84.

a. The uterus. *b.* The os uteri, or mouth of the uterus. *c, c.* The horns, one of which is laid open. *d, d.* The Fallopian tubes, with their fimbriated extremities. *e, e.* The ovaries. *f, f.* The broad ligaments. *g.* The urinary bladder. *h.* The opening of the bladder. *i.* The vagina cut open to show the passage leading to the bladder and os uteri.

or layers, viz. beginning from the outermost aspect, first a peritoneal coat, which is smooth and continuous with the lining of the abdominal cavity; secondly, a middle muscular coat, which furnishes the great contractile power, by means of which at the right time the calf is to be expelled from the womb in the ordinary course of nature; and lastly, the internal or mucous coat, whereto is attached the covering of the fœtus, so well known under the name of the after-birth, whereby the vascular connection betwixt the cow and the calf is maintained.

The fertilised ovum, having escaped from the ovary, is seized or entangled by the fimbriated extremity of the Fallopian tube, and subsequently passed along the tube into the uterus. If it be not caught by the fimbria, the ovum falls into the cavity of the abdomen, where it may perhaps become an extra-uterine fœtus, as occasionally occurs both in human beings and in animals. During the passage of the ovum into the uterus, it is covered by a membrane called the chorion, by means of which the developing fœtus becomes attached to the inner surface of the womb, and obtains from the parent the materials necessary for the maintenance of life and development. In the case of the cow and the ewe and certain other animals, the outer surface of the chorion is thickly studded with shaggy projections called *cotyledons.* These are attached to corresponding concavities in the membrane lining the wall of the uterus internally, the *tunica decidua uteri*, which contains the enlarged and elongated branches of the uterine arteries of the mother. It is by the medium of them that the minute branches of the blood-vessels of the mother and those of the fœtus come into contiguity, although they do not enter into direct communication with one another. Hence, the two sets of blood-vessels lying in contact, the blood of the fœtus is purified by means of the more highly oxygenated blood of the mother. The cotyledons may then be looked upon as subserving in some degree the functions of respiratory organs, and to some extent also as organs of assimilation.

The chorion consists of the false amnion fused with the allantoid membrane. In addition to the chorion there is also another membrane enveloping and immediately surrounding the fœtus. This is called the true amnion or water-bag, which contains the fluid in which the fœtus floats. By means of this fluid, the liquor amnii, the fœtus is protected from injuries, which might otherwise destroy its life. This fluid also, contained in its investing membrane, is also protruded into the mouth of the womb at the commencement of the act of parturition, thus acting as a hydrostatic dilator. The rupture of this bag, or rather the consequent escape of the fluid contained within it, is one of the earliest signs heralding the act of parturition. The space intervening between the chorion and the amnion acts as a receptacle for the urine of the fœtus. The

allantoid membrane is directly connected with the bladder of the fœtus by means of a tube called the *urachus*.

This tube, together with the blood-vessels connecting the fœtus with the chorion and its cotyledons, forms the umbilical-cord or navel-string, which is generally broken during the act of delivery. These blood-vessels are the arteries which convey the impure blood out of the body of the fœtus to the cotyledons, and the veins which return it, after it has been reoxygenated in the manner previously alluded to.

Due provision is made for an equal distribution of this pure blood through the body of the fœtus, so that every part of the frame may be built up at the same time.

The act of cleansing in the case of the cow generally takes place some hours after the calf is born. If the placental membranes, instead of being separated, are retained, they set up a great deal of irritation. They may putrefy, and death may in consequence ensue. Cows, suffering from a depraved appetite, have been known to devour their cleansings, and impaction of the rumen may result therefrom.

Now, the term œstrum is employed to designate that condition of the female which shows her fitness and desire for the male. It is associated with puberty, and passes off on the approach of old age. In some of our improved breeds of cattle, especially when well kept and attended to, œstrum comes on very early in life, and in such instances the animal often conceives when she is but little more than a year old. These early conceptions, however, too frequently prove injurious, both by interfering with the development of the frame of the female, and also by deteriorating the quality of the offspring.

Some animals, such as the dog and pig, which in a state of nature produce only one litter a year, will, when domesticated, bring forth several.

The immediate cause of œstrum is the existence of fully matured ova in the ovaries, and impregnation can only be effected when the ova are in this condition.

The time occupied in the development of the ova differs in different animals, and hence we observe a variation in their return to the male. Impregnation is produced by the fecundating fluid of the male acting on the matured ovum of the female, which action probably takes place in the ovarium. There is

some dispute as to the means by which the seminal fluid finds its way through the body and horns of the uterus, and from thence through the Fallopian tube to the ovary. Probably the spermatozoa, with which the seminal fluid abounds, move along by themselves. Hence the Fallopian tubes must be pervious, since if their lumen be closed, as has been proved by passing a ligature around them, the animal is thereby rendered incapable of being fertilized. The ordinary operation of spaying, *i.e.* the simple removal of the ovaries, destroys both the desire and the power of conception; whereas if an ovary be left, all other parts being cut away, the animal returns to the male, notwithstanding that she is sterile.

With regard to the signs by which we know that impregnation has taken place, it may be said that the cessation of œstrum is regarded as an indication in the case of the cow, that animal not returning to the male at the usual period, or refusing connection. As the calf gradually grows inside the womb, the capacity of the uterus increases, and becomes visible externally, especially on the cow's right side, where, indeed, at about five and a half months after impregnation, the calf may be felt. A general quietude may be noticeable together with a tendency to accumulate flesh, and in some animals, as for instance the mare, a sluggishness during work may be manifested. The *labia pudendi* are swollen and flaccid and red, and the redness extends into the vagina, from which a larger quantity of mucus than is usual is discharged. Shortly afterwards the abdomen increases in size, the loins droop, and the muscles of the croup become less markedly prominent. In fact the abdomen gradually becomes larger and larger, and hangs down, so to speak, and at its lower portion exhibits a round appearance, with a falling-in immediately beneath the bones of the loins. If one gently but firmly thrusts against the animal's flank, a hard lump, which in reality is the fœtus, may be felt. At a later stage the movements of the calf in the uterus may be seen, and the mouth of the uterus may on examination be found to be closed.

As the period of labour approaches, the mammary gland enlarges, the secretion of colostrum takes place within its follicles, and the teats become hot and full.

When delivery is about to be effected, the animal becomes

restless, often lies down, strains, rises again, changes her position, looks to her flanks, and carries the tail higher than is usual.

During the earliest periods of gestation it is very difficult to decide if an animal is pregnant. In cases when the hand can be passed up the rectum, the presence of the fœtus can be detected in the form of a small, roundish, and slightly movable body situated below and without the intestine. If the hand be quietly kept in this situation, and pressed upon the enlargement, voluntary movements in the living embryo will now and again be recognised. Some persons prefer to introduce the hand into the vagina, and carry it towards the os uteri so as to ascertain its condition, for the mouth of the womb is closely shut during gestation, and at this time it contains a layer of thick albuminous matter. However, such manipulations are liable to lead to abortion, and hence should not be resorted to. Percussion over the uterus is also of great assistance in regard to diagnosis, and some persons speak of auscultation most favourably, maintaining that the sound of the fœtal heart can often be detected.

The percussion should be carried out on the right side, the rumen being situated in the left division of the abdomen. If the period of gestation be advanced, fœtal movements can be seen while we stand by the side of an animal. In the case of the mare, the custom is not unfrequently practised of giving cold water to drink for the purpose of making the fœtal movements stronger and quicker. However, this is a very reprehensible practice, since spasms and even death may be induced by it.

As a rule the mare carries her young for nearly forty-eight weeks, the cow forty, the ewe twenty-two, the bitch nine, and the sow sixteen. According to Earl Spencer, the probable period of gestation of a cow should be considered to be 284 or 285 days.

Dr. Carpenter remarks that "the average length of time which elapses between conception and parturition in the human female appears to be 280 days or 40 weeks. We must attribute the prolongation of the period to some peculiarity in the embryo, derived from its male parent."

Earl Spencer observes that "from the cows whose period

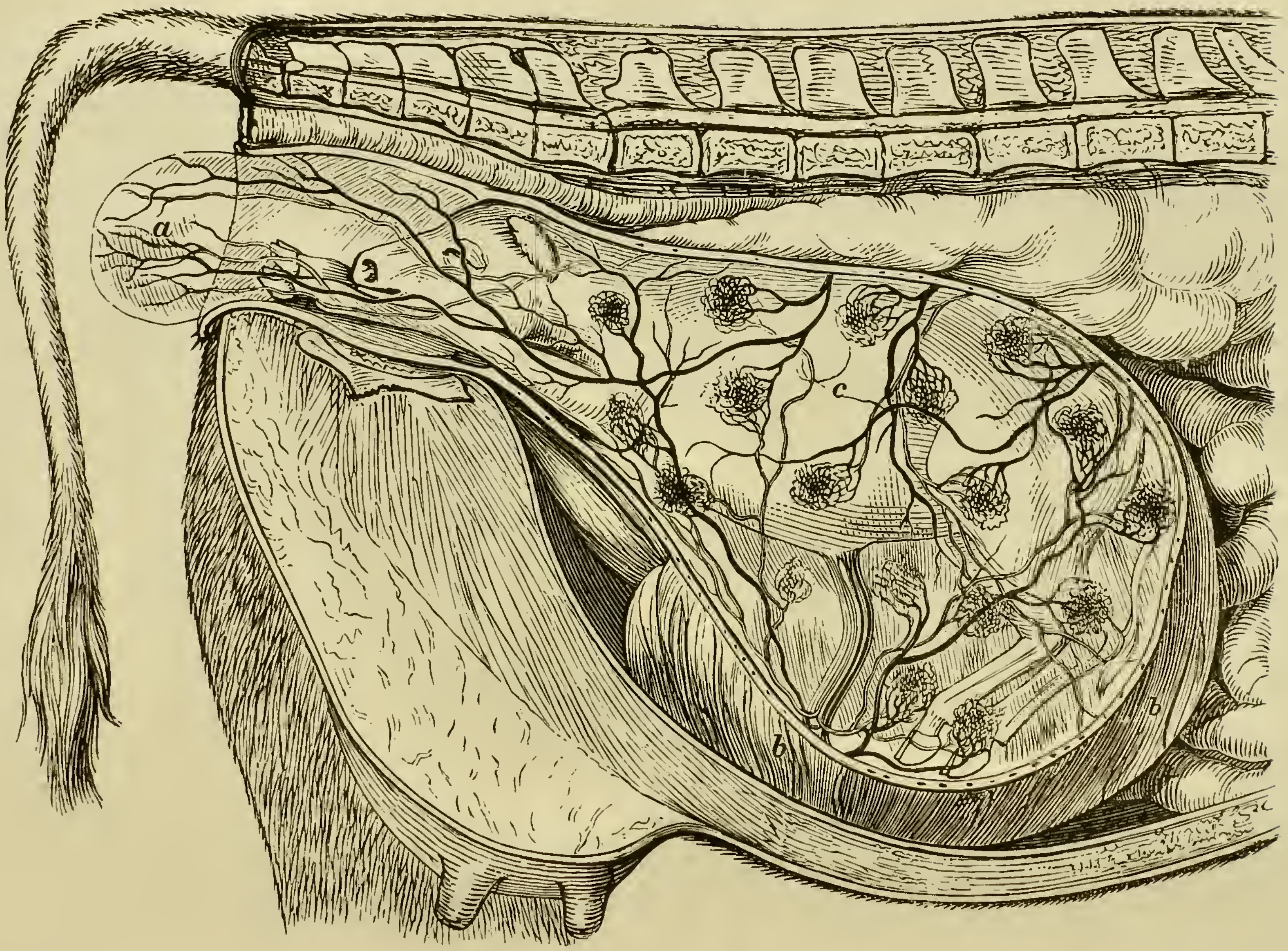


FIG. 85.

a. The water bladder. *b*. The uterus. *c*. The fœtus enclosed within the amnion.

In the above figure the calf is seen, placed in its natural position, and covered by the amnion, which, with its contained fluid, is protruding from the shape.

of gestation did not exceed 286 days, the number of cow-calves produced was 233, and the number of bull-calves 234; while from those whose period exceeded 286 days, the number of cow-calves was only 90, while the number of bull-calves was 152." Hence it seems to be the case that when the time of gestation of a cow is longer than usual, the produce is generally a male calf.

Labour, although perfectly natural, may occupy some time, or be rapidly effected. In the mare delivery is as a rule quick, the birth of a foal rarely occupying more than a few minutes. In the cow half an hour may be regarded as about the average time after labour-pains have shown themselves, while in the ewe it not unfrequently happens that several hours may be spent in labour.

We have now to consider briefly the ordinary mode of delivery. As the time draws near, a discharge of thick mucus may be observed, the mammary gland becomes swollen, hot, and full of *colostrum* (the first milk), the ligaments of the pelvis give way, the cow becoming "down in her bones." The cow separates herself from the herd, if in the field, and shows signs of uneasiness. When delivery is at hand, the animal evinces great restlessness, lies down and rises again quickly, and the labour-pains come on and gradually increase in intensity, until after a time the act of bringing forth takes place. This will be generally about 280 days or perhaps a few more after impregnation. The cow may assume the recumbent posture.

The symptoms denoting the approach of labour are in fact restlessness, frequent change of position, lying down, quick rising, straining, and so forth.

These all indicate an excited state of the system accompanied with pains of a bearing down and intermittent character.

The amnion is first protruded and then ruptured, a watery fluid being consequently set free. Then the fore-feet of the calf appear, and soon afterwards the head also shows itself, as it rests upon the legs near the knees, and finally and slowly the whole animal. (*See* Fig. 85.) The act of delivery may be said to occupy in the general way about an hour.

In giving aid, it is important to remember that advantage should be taken of each labour-pain, gentle force being applied by pulling the fore-legs, and, if necessary, the head also. In

urgent cases it may even be found advisable to fasten cords carefully round both the legs and the neck of the calf. When, however, the presentation is the natural one, as above described, and the labour-pains are not severe, no measures of this kind should be taken, since the pains may come on and go off again for some hours, and again they may return, yet again to disappear. If, in such a case as this the mouth of the womb is known to be only slightly dilated, the animal should be left alone in perfect quiet for a few hours. Especially should young animals with their first calves be treated in this manner.

Proprietors should not be in too great a hurry with their animals at the time of parturition, although these may express much uneasiness by continued straining. Symptoms of approaching parturition have in certain cases disappeared, and not returned for two or three days.

A careful examination may be made, and, should the mouth of the womb be found only partially dilated, we may safely leave the animal to nature's own efforts. In extreme cases of this kind one fluid ounce of tincture of opium may be administered to a cow, and followed up with an ordinary aperient.

The act of parturition is in part effected by the contraction of the muscular coat of the womb, and partly by that of the abdominal muscles. The mouth of the womb being freely dilated, the simultaneous and repeated contractions of the uterus and abdominal muscles propel the fœtus, covered by its membranes, first towards and then into the vagina. This advance is assisted by its position, and also by the pushing forwards of the liquor amnii. This fluid, contained within its proper membrane, is usually called "the water-bladder." As soon as it bursts, the propulsive action of the uterus is brought to bear immediately on the body of the fœtus, by which means the latter is expelled.

The membranes are cast off by means of a more gradual action of the uterus, by which the cotyledons are in the first place detached from their connections, and then the membranes are ejected by an augmentation of the propulsive power.

After this, the womb contracts with some force upon itself, and thus effectually compresses the mouths of the uterine vessels, and stays the escape of blood.

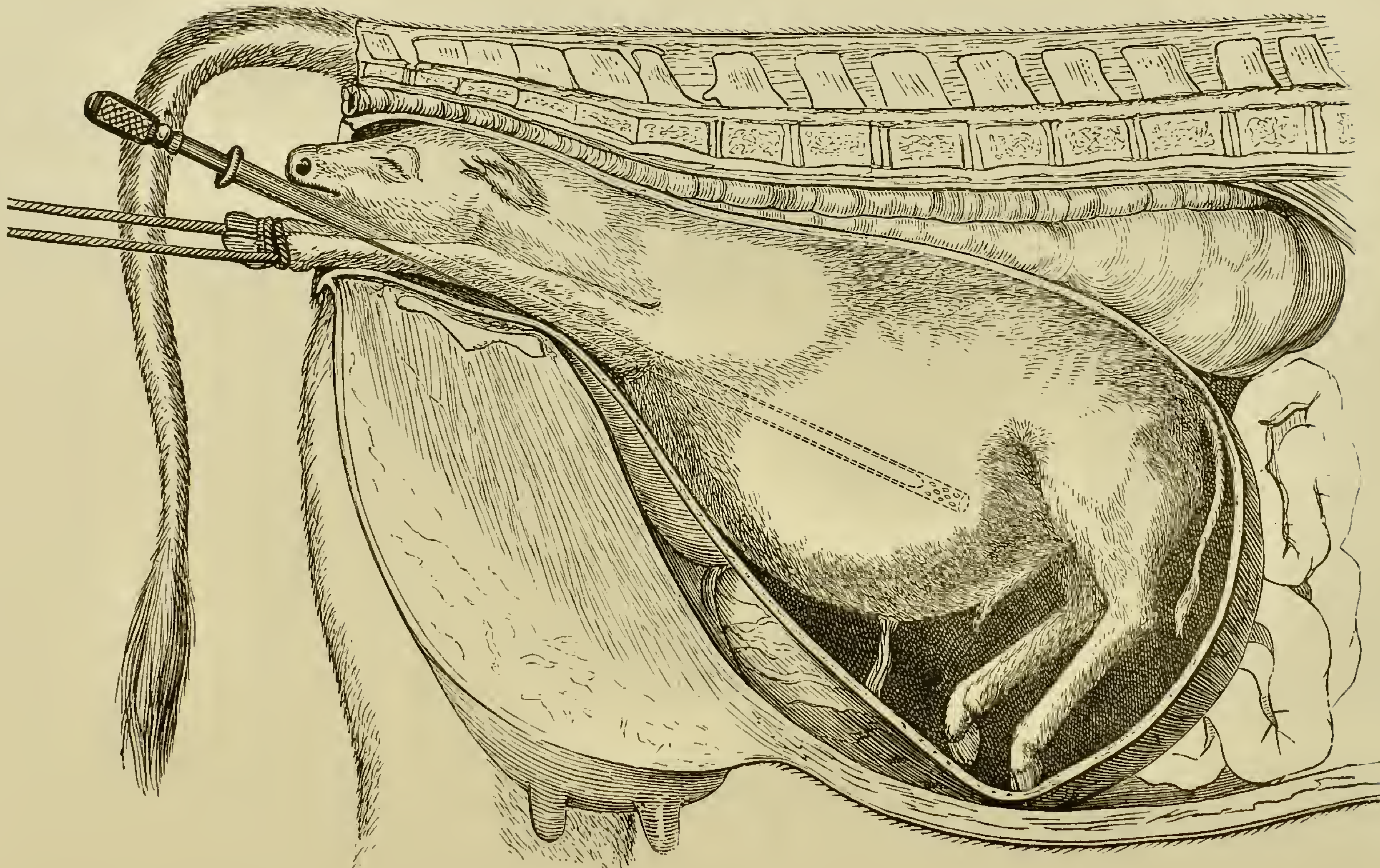


Fig. 86.

If delivery be difficult owing to the fœtus being too large for the womb, then assistance ought to be given during the continuance of each alternate pain.

Occasionally the veterinarian may be called to a simple case in which the act is merely a little delayed. If so, a mild stimulant may be useful, or in extreme cases a little of the fluid extract of ergot of rye may be prescribed. The greatest precaution is, however, necessary in regard to the use of this drug. It should never be administered, unless one is quite certain that there is no real impediment or obstacle, and also that the os uteri is relaxed. In order to determine the position of the fœtus in the uterus, the hand may be introduced. The primary aims to be sought in all cases of difficult parturition are the strengthening of the cow and the restoring of the calf to the natural position.

Sometimes it may be the case that a calf *in utero* may be afflicted with dropsy of the abdomen, and so, on account of its greatly increased size, present a very grave obstacle to delivery taking place. In this case, the life of the fœtal calf must be sacrificed at once, and exit should be given to the fluid contained in the abdomen of the fœtus by thrusting a trocar of sufficient length right through the chest of the fœtus, and into the abdominal cavity. The stilet should be withdrawn, and then the pressure brought to bear on the fœtus, partly by the labour-pains of the mother, will forcibly drive the fluid through the sheath of the instrument, thus reducing the size of the enlarged abdomen and facilitating delivery. The very greatest care is requisite in performing this operation. Perhaps in certain cases it may be possible to pass the trocar directly into the abdomen of the fœtus.

Professor Simonds was led to the subsequent employment of this instrument owing to the difficulty once experienced in the case of a mare in labour, where the obstruction to the progress of the delivery was due to the accumulation of a large quantity of urine within the bladder of the fœtus.

The instrument is depicted in Fig. 86.

Among other causes of lingering labour as a result of congenital disease, and where the presentation is natural, we must mention an accumulation of fluid within the cranial cavity (water on the brain). In such cases the body of the fœtus is unusually small,

so that we have but little to apprehend if we can succeed in reducing the size of the head. (*Vide* Fig. 87.)

Having satisfied ourselves, by an examination, of the real condition of the parts, let the fore-legs be returned into the body of the uterus in order to make more room.

Then place a hook attached to the end of a cord within the orbit, draw firmly at this with the left hand, so as to fix the head against the brim of the pelvis below, and the sacrum above. By means of the right hand introduce with very great care an instrument called a perforator, thrust its point through the bones of the head, and split them asunder by compressing the handles of the instrument. The bones of the head must be effectively crushed, great care being exercised in this process. We should here say that in all cases when certain parts of the fœtus are to be put back into the uterus, they should first be secured by ropes, so that, when it is necessary, they can be drawn out at will. When the cranial bones have been crushed, an exit will thereby be given to the fluid in the cranial cavity, and the fœtus will therefore be capable of passing through the pelvis. Of course the legs of the fœtus must be brought one after the other into the vagina, when moderate traction will in all probability suffice to withdraw the fœtus, the force being applied in this, as in every other case, only during the maternal efforts.

Among the varieties of natural delivery we must speak of *twin-labour*. As a rule, one fœtus is presented with the head and fore-legs advancing, and the other in the reverse position.

Now sometimes first one calf and then after some little time another one, and then again after some little time even a third may appear. In the case of twins, the fore-leg of one calf and the hind-leg of another may be presented, or there may be two fore-legs and one hind-leg. It is necessary that the calf whose fore-legs appear, or the one which is first presented, should be adjusted correctly, and then that the other should be for the time being returned into the uterus. In all cases, if there has been some difficulty in parturition, one should, after the birth of a calf, explore the uterus by means of the hand, with the view of ascertaining if another be present or not.

As we have pointed out above, there is great danger to be apprehended if the fœtal membranes be retained. Should this be the case, it will be best to remove them, using great care,

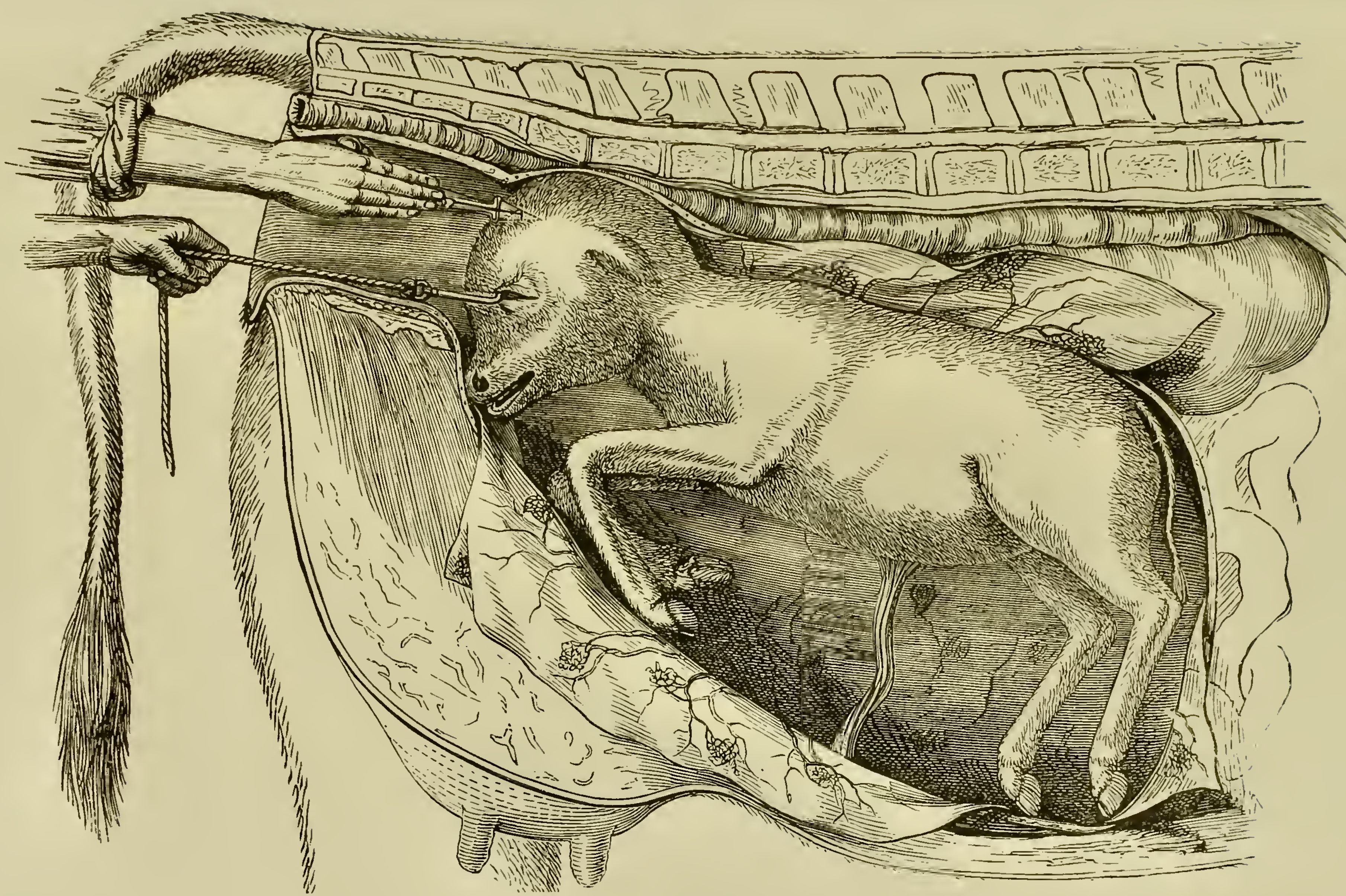


Fig. 87.

since otherwise they may decompose, and so give rise to septic disease of the general system, as will be manifested by febrile symptoms of a severe character. Retention may be due, either to a want of the necessary expulsive efforts, or to entanglement. Sometimes it may be found useful to roll the parts of the cleansing which protrude round two thatch-sticks, and so gradually rolling them round and round, draw what remains away by degrees. Sometimes it may be well to introduce the hand, and carefully separate the cotyledons from their points of attachment. This method, however, should only be resorted to as a last resource, and it is well to remember that, if they are at all forcibly separated, serious bleeding may come on.

Again, after-pains may supervene as a result of the retention of fœtal membranes, or as a consequence of injury to the womb, or of some cause of irritation in the intestines. After delivery has taken place, the womb slowly contracts, though it cannot do this effectually so long as the membranes remain. This contraction causes an arrest of the flow of blood. If the after-pains are severe, it may be found advisable to administer a dose of antispasmodic medicine.

Further, there may be a more or less profuse discharge of blood from the womb. The blood may be clotted, and the animal will show restlessness and weakness. In these cases cold water may be continuously applied to the loins, or cold or warm injections into the uterus may arrest the flow. It is necessary in such cases to use a double-tubed injector, and to fill both tubes of the injector with the fluid to be injected before passing it into the womb. It is well to add some antiseptic to the fluid. The ordinary hæmostatic agents such as perchloride of iron may be tried by the veterinarian, and in some cases he may find it wise to administer a suitable stimulant internally. Moreover, after delivery has been effected, the cut or ruptured end of the cord may bleed. This will probably soon cease, but, in any case, ligatures should be applied to the two ends. It is a peculiar fact that cows will, before and after parturition, devour all kinds of extraordinary things, and, after delivery, even the fœtal membranes.

Numerous different kinds of abnormal presentations may be met with, and we now proceed to mention some of the chief of these.

(*a.*) Instead of both fore-feet and the head, one fore-foot only,

together with the head, may appear. If so, a cord should without delay be fastened securely round the lower jaw, and another round the foot presented, so as to make sure of these two structures. Next, the hand, holding the slipping noose of a rope, should be gently introduced into the uterus, and the other flexed fore-limb should be found. From the point of that leg which is first touched, the hand should be carried down towards the fetlock, and when this is reached, the noose should be slipped on the fetlock. While the cord is being pulled with the object of straightening the flexed limb, matters may be facilitated by pushing the fœtus backwards into the womb.

(*b.*) The fore-feet may be presented, while the head is doubled more or less completely backwards, lying close to the side of the young animal, so that the side of the neck is presented. (*See* Fig. 88.)

In the figure below the calf is represented as having its two fore-legs passed through the mouth of the uterus into the vaginal passage, while the head is turned back and lies in contact with the side of the young animal. This presentation is of common occurrence.

This position of the fœtus arises from the head being turned a little aside. The difficulty of adjusting the fœtus, and effecting delivery will be proportionate to the distance the head is placed backwards. In some cases it will be within our grasp, while in others we can only succeed after repeated efforts have been made to reach the ear or the orbit.

We must secure the fore-legs by passing round each, just below the fetlocks, a cord having a running noose. The legs are then to be returned into the body of the uterus. The head should then be sought for, and, if possible, a rope should be fastened round the lower jaw, or, if this cannot be effected, a hook should be fixed cautiously, firmly, and securely, so that it cannot possibly slip, into the orbit of the fœtus. The hook is, of course, fastened to a rope, or fixed by means of a hinge to one end of a steel rod provided with a cross handle at the other end. Then the chest of the fœtus must be pressed back, so as to cause the fœtus to sink deeply down into the womb, after which pressure is to be made upon the curved side of the neck or chest, which pressure must resist the propulsive efforts of the mother, when it will be found that the neck will be thus

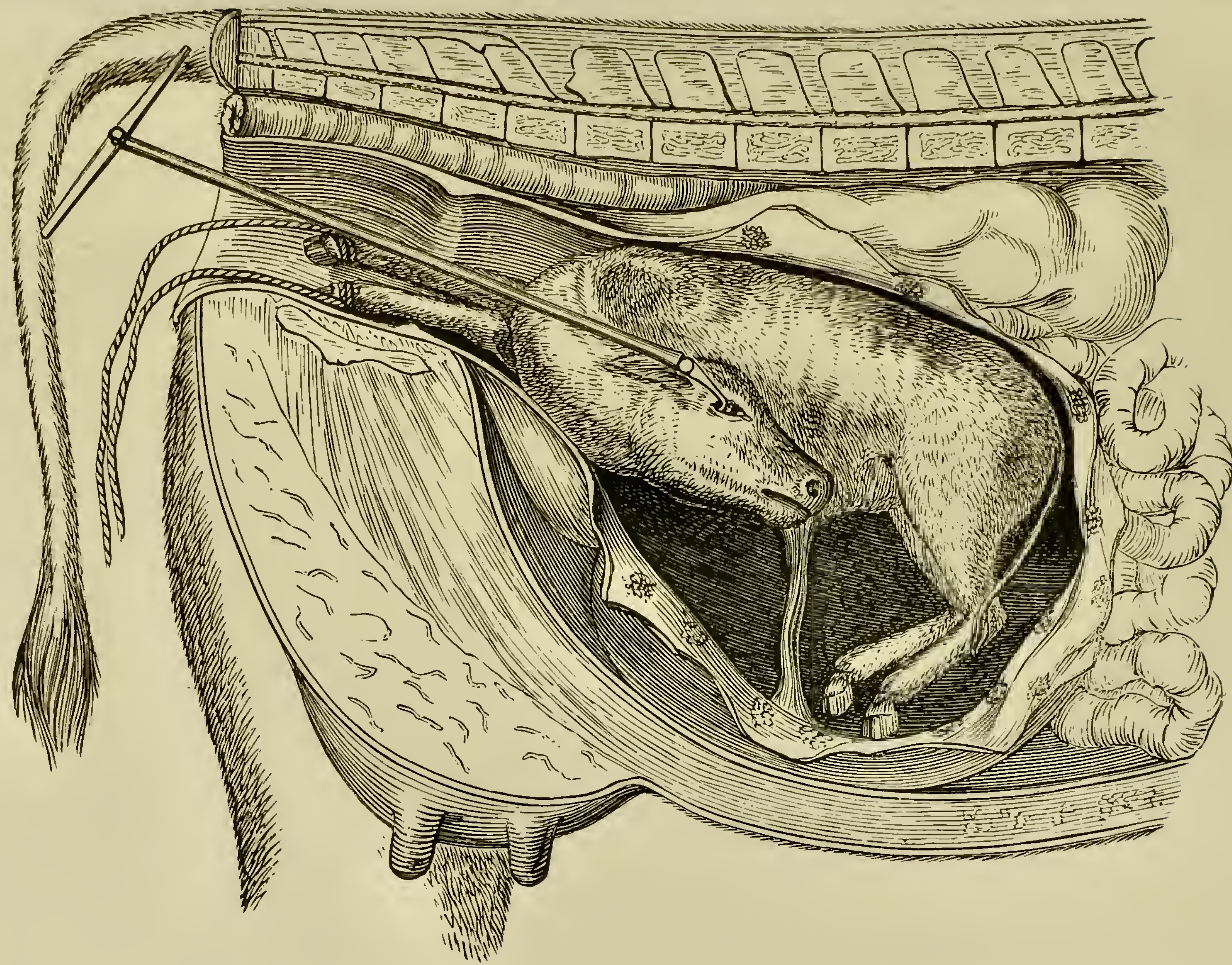


Fig. 88.
This illustration is described under (*b*).

straightened, and the head consequently brought nearer to the pelvic opening.

Now bring the fore-legs forward again, and at the same time pull the cords firmly, so as to bring the head in position, and then delivery may be effected. In extreme cases of this kind of presentation the fœtus is often found to be dead, and if so there is reason for using instruments in order to aid our efforts. A hook attached by means of a hinge-joint to a steel rod, and having at the other end a cross-handle removable at pleasure, is a very useful instrument. The operator, taking the hook in his hand, and carrying it towards the orbit, directs his assistant to advance it or draw it backwards, as he may find necessary in order to aid his efforts to place it within the orbit. After having adjusted the head, the legs are to be brought up by means of the cords, and delivery is then to be effected in the usual manner.

Sometimes, however, it may be found quite impossible to secure the head. If this is found to be the case, the best plan is for the surgeon to proceed carefully to cut up the calf, removing first the fore-legs. This is effected by concealing a small knife in the palm of the hand, and making with it a deep incision from the fetlock of the fœtus to the shoulder. The skin may then be separated from the leg by passing the finger between the skin and muscles. By the application of some degree of force, the whole of the leg can be pulled away. The other fore-leg should then be treated in the same way, and ropes should then be attached to the loose skin. Then there will be more room for securing the head.

Sometimes, however, it may be found necessary, by means of a strong, short scalpel, to disarticulate the skull at the first or the second cervical vertebra, and then to detach the head, and so complete the delivery. If only one fore-leg projects, the best course is to secure the other foot, and then proceed as above, so far as may be found possible.

(*c*.) The next form of presentation which Professor Simonds describes is that shown in the figure which is represented in Fig. 89. It will in this illustration be seen that the head of the fœtus is alone protruded, the neck of the animal being in the vaginal passage, the rest of the body occupying the uterus, and the two fore-legs being situated down in the body of the uterus.

If the case be very extreme, as is shown in the figure, it will be quite useless to attempt to return the head and draw away the fœtus, as all such efforts could only be futile in such an instance.

On the contrary, the fœtus must at once be sacrificed, in order that the life of the mother may be saved. An incision should be made through the skin from the poll to the muzzle, and another from the gullet to the end of the lower lip. Dissect the skin on either side from off the head so as to unite the upper and lower cuts, and then detach the skull from the trunk at the occipital joint. Then attach a cord to the incised skin, and put back the neck into the womb. Feel for, and place in their proper position, the fore-legs, then bring up the neck and deliver. If it should be found impossible to put back the head into the uterus, the best plan will be to detach the head from the neck, leaving sufficient loose skin attached to the neck as will make it possible to fix a rope to it. However, it may perhaps be found advisable to fix a hook firmly into one of the vertebræ of the neck, or in the interval between two vertebræ.

Should the head be presented, but not actually so far as to project, the first thing to be done is to secure the lower jaw of the fœtus, by passing a cord with a slip noose round it, and then the head should be pressed back into the uterus. In the next place, the fore-legs are to be carefully sought for, and, when found, elevated, and separately secured by means of cords as above described, and then they are to be drawn upwards with firm but rightly-applied force. Then the head is to be brought forward by drawing at the cord on the jaw, and, force being applied to both head and legs, delivery is to be effected. It is necessary to bear in mind that, by attempting to deliver by means of the head alone, a great deal of damage may be done, while no benefit could possibly ever result from taking this course.

(*d.*) The position which we are now about to describe is that depicted in Fig. 90. In this illustration the right fore-foot of the foal is seen to be protruded through the mouth of the uterus. The left foot is directed downwards in the body of the uterus. The head, too, is situated in the body of the womb, and it is curved with the nose directed downwards, so as to be brought

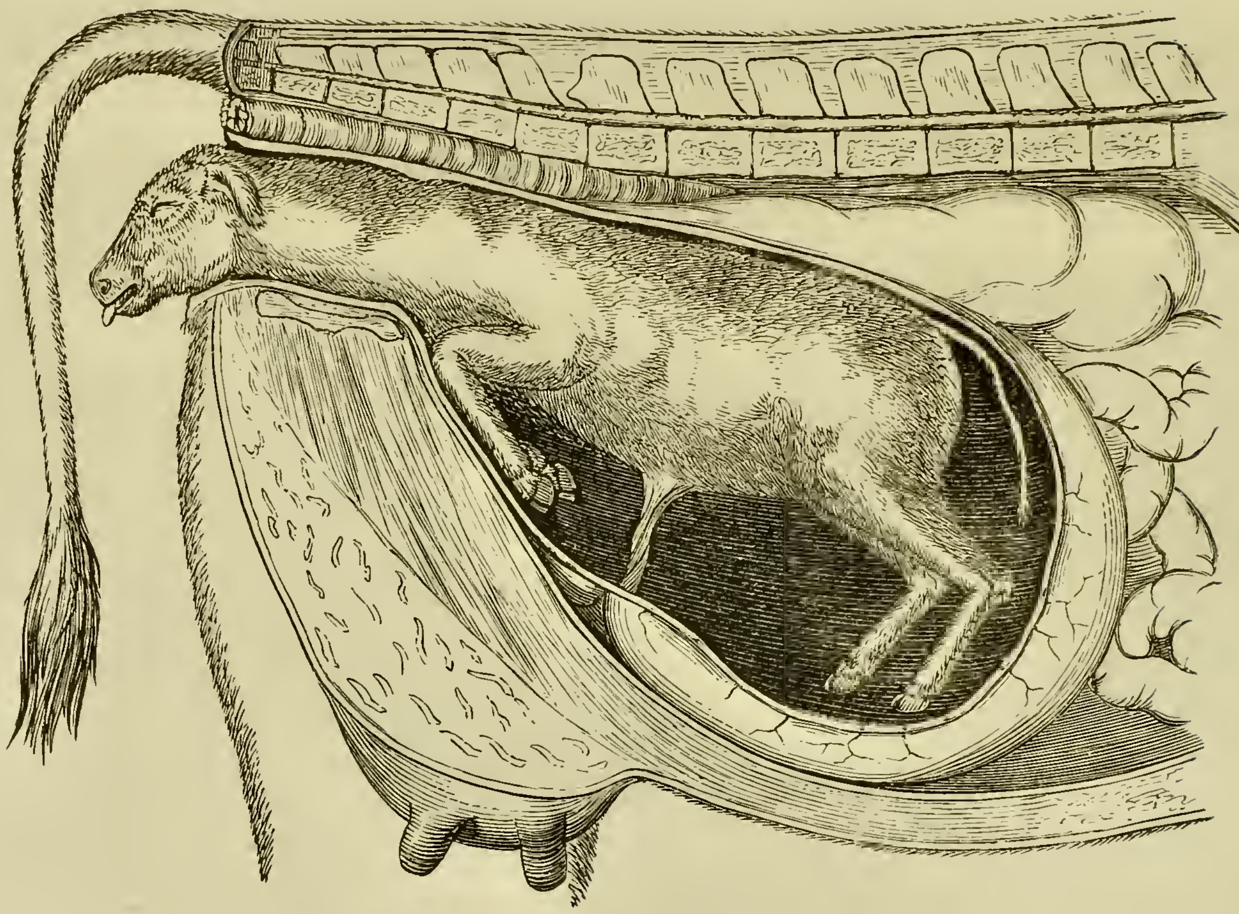


Fig. 89.

The presentation shown above is described under (*c*).

near to the front of the neck. The forehead is pressed against the brim of the pelvis, and the tip of the forehead and part of the upper surface of the neck, together with the right fore-foot, are the only parts which can be readily felt by the operator. The occipital bone of the skull is presented, and hence this position of the fœtus is called the occipital and foot presentation. Unless the labour pains should be very powerful, this position of the fœtus does not entail great difficulties.

In the first place, a cord should be fastened round the fore-foot which is protruded. Then the hand should be passed into the womb, and, if it is possible to do so, a cord should be fastened round the lower jaw. If this cannot be done, a hook with a cord attached to it should be fixed into the orbit of the eye. The hand is then again to be introduced into the womb, and, following the direction of the protruding limb, carried towards the chest of the fœtus. Pressure should then be exerted on the chest, so as to push the fœtus backwards as far as possible into the uterus. As soon as this is done, the hand is to be shifted to the upper part of the neck behind the occiput, when moderate pressure being applied here will straighten the head and neck, so that they assume their natural position. The assistant must then gently pull the head by drawing the cord attached to it moderately tight, so as to prevent the head being again bent downwards. Another cord must now be carried in, and fastened securely to the other fore-leg, as is represented by the dotted line shown in the figure. The legs and the head are then to be pulled with moderate force, and the fœtus will be withdrawn.

In this connection we may point out that it is always preferable that a cord should be fastened round a part, as, for example, round the jaw, than that hooks should be employed. The cord cannot do any damage, while the hooks, if they should become loose, or slip and become imbedded in the walls of the uterus, may cause much laceration of the tissues, and even death might result from such an untoward accident. Hence the very greatest care is necessary in the employment of hooks.

(*e*.) The next position of the fœtus which we now proceed to describe is that depicted in Fig. 91. In it the fœtal calf is represented lying on its back in the womb. Its legs, instead of being directed downwards, are directed up towards the spinal

column of the cow. The back of the fœtus is in contact with the lower wall of the uterus. The top portion of the skull and the nape of the neck are presented. In these cases labour is of long duration, and various measures are resorted to by practitioners in order to adjust the fœtus before employing traction to remove it. The fœtus must be turned, but to effect this turning in the case of the cow is a much more difficult operation than it is in the ewe. The head should first be secured by fastening a rope round the lower jaw, so that at will it may be brought forward. Then similar cords should be secured round each fore-leg, the cord attached to the leg represented in the foreground being on the outer side of the other limb marked *a* in the sketch. That is, the rope fixed to one of the fetlocks should pass to the outside of the opposite fore-limb, so that the two fetlocks can be drawn to the same side of the head. Then, while the operator presses his hand strongly against the withers in a rotatory manner from below, the assistant should be directed to pull with special force the rope which passes to the opposite side, and also tightly at the other rope as well. If skilfully and properly performed, these measures should cause the legs and then the head to be brought into the vagina, and the fœtus to turn. It may then be withdrawn with safety.

However, this turning is by no means easily effected. If forward pressure applied from below, together with very energetic pulling at the same time employed, does not succeed, the calf must be cut up, the limbs being first detached, attempts being then made to deliver by pulling the head, and the position of the fœtus being adjusted from time to time.

(*f.*) If the fœtus lies on its back and the hind-legs are presented, it is advisable either to extract by pulling the hind-legs, or else to detach these legs as high up as possible, to adjust the position of the fore-legs, and to deliver by means of the application of a moderate amount of traction. This position is readily intelligible, and therefore is not depicted by means of an illustration.

(*g.*) The fœtus may lie on its back, and the hind-feet be inclined forwards instead of protruding. If this be the case, the calf must be pressed downwards and forwards, and then the hocks must be flexed, and the hind legs brought carefully into the vagina. Another plan is to amputate the two hind-legs at

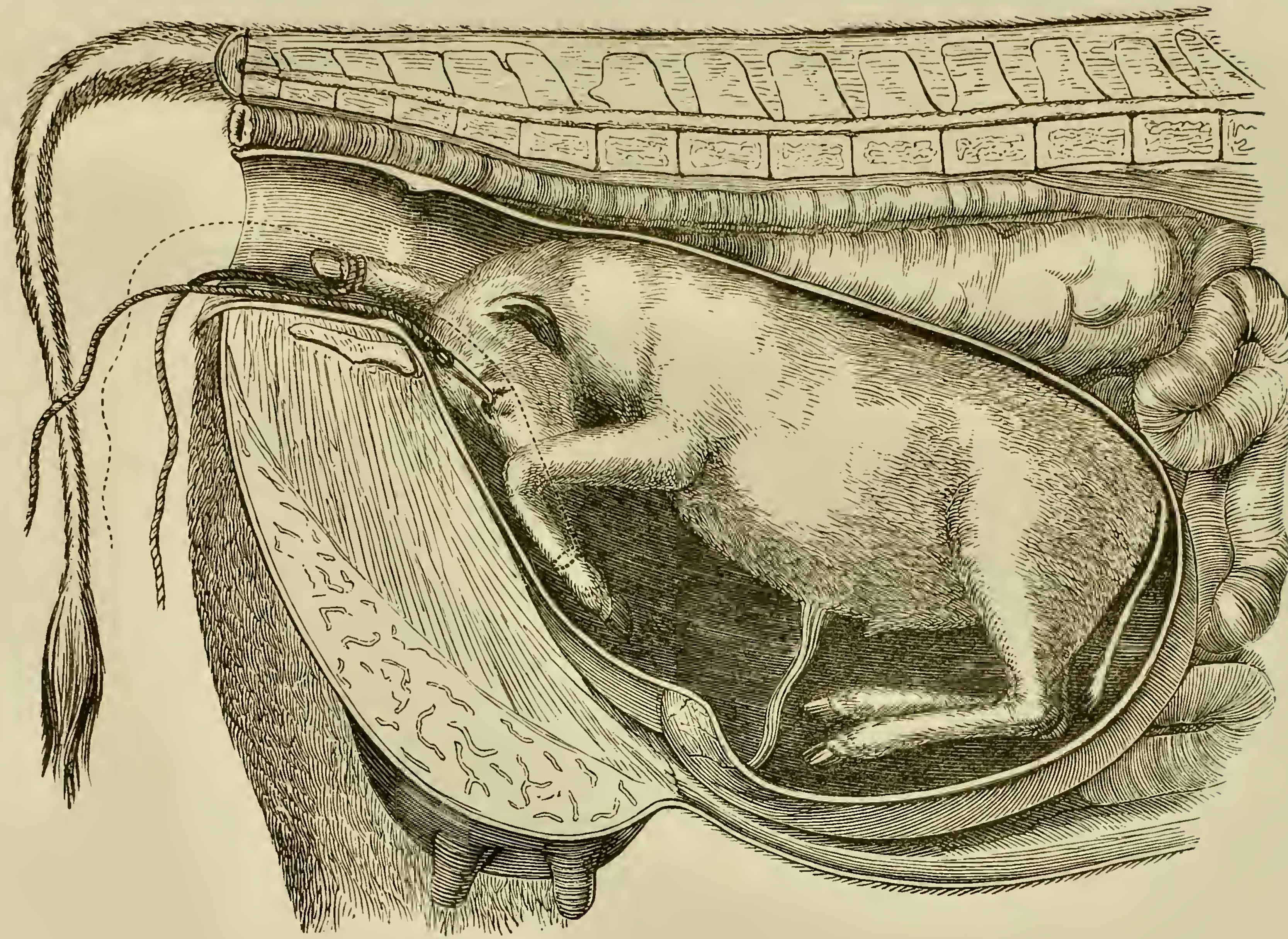


Fig. 90.
The presentation above depicted is described under (*d*).

the hip. Sometimes this latter method may be necessary. This position is likewise easily intelligible, and is therefore not illustrated by a picture.

(*h.*) The presentation now to be described is illustrated by the two figures numbered 92 and 93 respectively, the first of these pictures showing the position itself, and the second depicting the successful accomplishment of what the veterinary surgeon should strive to bring about.

In Fig. 92 the fœtus is seen to be lying with its head directed towards the chest of the cow, having its hinder parts, namely the breech and the tail, alone presented and pressed against the brim of the pelvis, and the hind-legs doubled up under the body. It is clear that the hind-legs must be brought into the vaginal passage, and in order to effect this adjustment an instrument invented by Professor Simonds should be used. By means of this instrument a cord is passed round each thigh, then the body of the fœtus is pushed forwards by the aid of the crutch, and the loop is passed down to the fetlocks. Then, the pressure being still applied, the feet are drawn by means of flexure of the hocks and other joints into the vaginal passage, and removal is then effected. This method may be described somewhat as follows :—

The instrument sketched in Fig. 92 consists of a curved piece of steel having an aperture at one end, to which a small cord is attached. At the other a female screw is placed, and this admits of its junction to a whalebone staff, and between the two another opening exists, into which a stronger cord is inserted. Taking the staff with the two cords in his hand, the operator is to pass the instrument between the thighs of the calf, and push it in front of the stifle-joint, and then with a turn of the wrist to direct the small cord outwards. An assistant holding the instrument, the hand of the accoucheur is now to be introduced and directed to the front part of the stifle-joint, when the cord can be readily grasped and brought out. Thus the limb will be embraced between the two cords. The whalebone staff is then to be detached, and the smaller cord to be run through a noose at the free end of the larger one, when, by drawing the smaller cord, the curved part of the instrument will travel round the limb, bringing with it the larger cord, and thus a looped ligature will be placed upon the leg above the hock.

The like proceeding is to be adopted with the other leg. The operator must next push the body of the fœtus forwards by either placing his hand against the breech, or using for the purpose an instrument similar to an ordinary crutch. By these efforts he will succeed in flexing the hock-joints, and be able to pass the loops downwards to the fetlocks. Having accomplished this, a careful manipulation will allow of his bringing up the feet towards the os uteri, and at last to turn the legs so as to place them in position of Fig. 93, after which ordinary traction during each throe will enable him to effect delivery with safety, both to the mother and the young. It may, however, often be the case that efforts to get hold of the fetlocks will prove futile. If so, it will be necessary to perform the operation of embryotomy, and one point to be always borne in mind is that a limb should never be removed before having dissected back the skin, so that the various instruments may be attached to it. The position of the animal is of great importance, and the animal should remain standing. During protracted labour, stimulants should be administered. Good ale, together with some alcoholic spirit, is very useful. After delivery a dose of from one to two fluid ounces of tincture of opium may be very valuable, in the case of a mare or cow, or half a fluid ounce to a sheep.

Now that we have done something to describe the chief kinds of abnormal presentation liable to be met with in cattle practice, we may as well say that the exercise of great care and judgment, coupled with common sense, would suffice to save very many of the hundreds of animals which are annually lost, owing to the want of the right kind of assistance. There is no doubt that very many animals are yearly sacrificed as a result of the lack of skilful help.

The most important disease connected with the act of parturition is one which we have already considered under the heading of "Disorders of the Nervous System." Milk-fever or parturient apoplexy, or puerperal apoplexy, seems to be almost characteristic of the bovine race, and it probably arises from congestion of the brain. This serious disease generally occurs in the cow soon after calving, namely, from about four hours up to about three days after that occurrence has taken place; although it has been

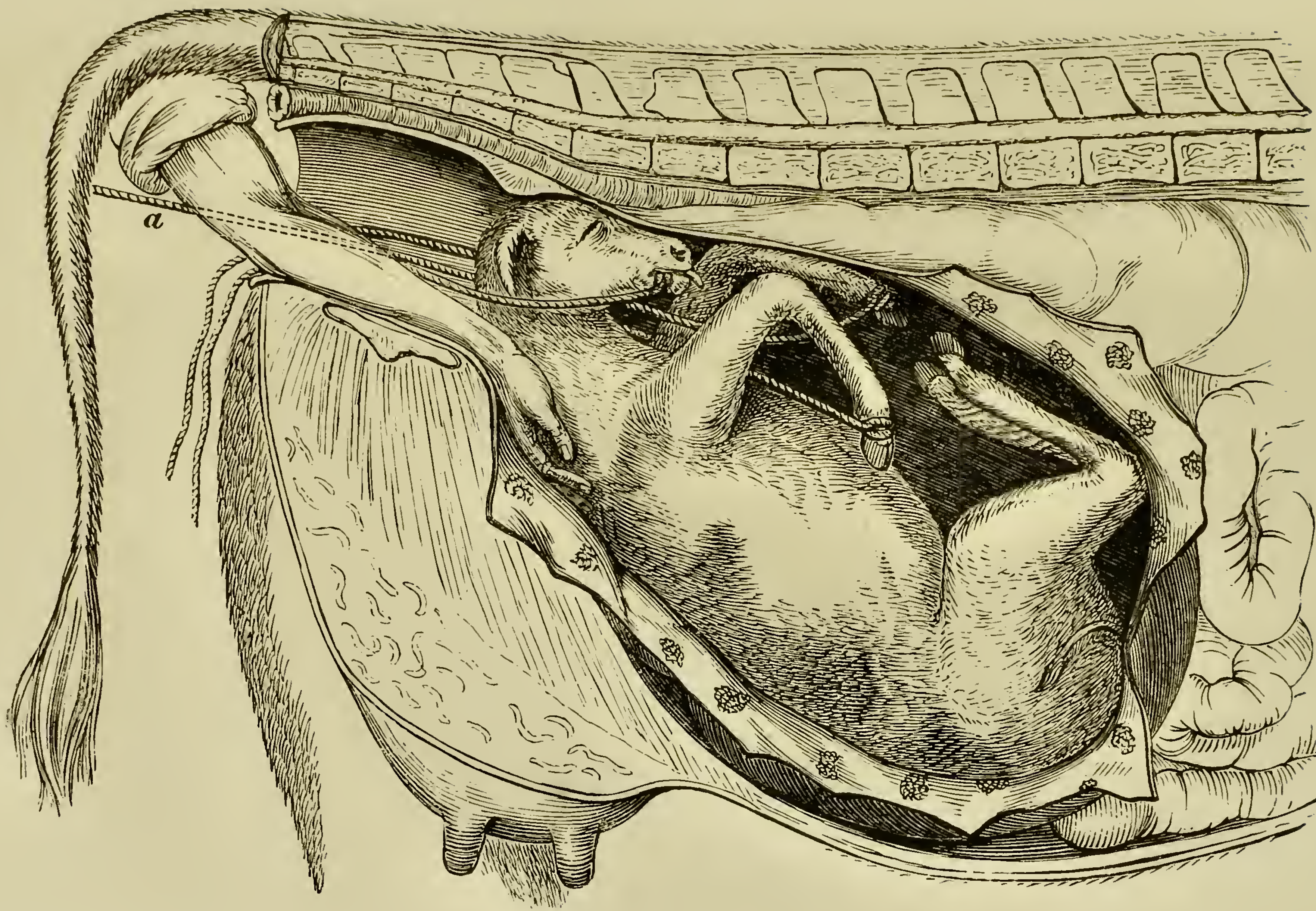


Fig. 91.
This figure depicts the position described under (*e*).

said that it may even occur before parturition, or sometimes even as long as several weeks after it. The fever most frequently manifests itself after an easy delivery, in warm weather, in plethoric animals, in good milkers, and in old animals seldom before the third calf, and most generally after the fifth. In those cows which have once suffered from this serious disorder it is very likely to come on again.

A short time after delivery has taken place, a cow afflicted with parturient apoplexy grinds the teeth, raises first one hind-foot and then the other, breathes a little more quickly, dislikes movement, and, if caused to move, progresses onward with a staggering gait, loses appetite, ceases to chew the cud and to give milk, has a staring look in the eyes, and becomes comatose. The hind-limbs usually lose their power and give way about twenty hours after the first onset of the disease, and the animal then falls to the ground, and remains in the recumbent posture, not being able to rise up at all, or, at any rate, only with the greatest possible difficulty. The eyes are now bloodshot, they protrude, and are insensible to the touch ; the pupils are dilated, and they will not contract if light is allowed to fall upon them. There is a loss of sensation all over the body, the prick of a pin on the hind-limbs, for instance, not being felt, and moreover there is a loss of power of voluntary motion. The pulse is full, soft, and slow ; but as the disease progresses it becomes faster and smaller, and finally imperceptible. The breathing, too, is at first quick and afterwards becomes difficult, slow, and after a time assumes a stertorous character. The mucous membranes are purple in colour, and the head and horns are hot. As the disease progresses in its fatal course, the brain becomes more and more profoundly affected. The head may be either pressed to the side or thrown quite back, with the horns resting on the ground. The animal may probably be delirious, and dash its head about with excessive violence, or it may on the contrary lapse into a state of complete coma, and lie with the head turned round on the shoulder. The muscles of the eyelids twitch convulsively, the udder retains its soft condition, or it may perhaps become small and hard. The animal cannot swallow, the urine is not evacuated, but remains in the bladder, and the bowels do not act. Indeed, obstinate constipation of an increasing character is manifested from the commence-

ment of the malady. The animal becomes blown up with wind, more and more comatose, and at length death closes the scene. In some cases, especially if the animal be well managed and treated, recovery may be hoped for. There is, however, danger of a relapse, and with the view of obviating this risk so far as may be possible, the patient should be most carefully attended to, and also occasionally turned, in order that it may not lie for too long upon the same side. After death the veins may be seen to be distended with black blood, and there are petechiæ on various serous membranes. The brain and spinal cord show congestion and extravasation of blood. The viscera are healthy, but the vessels of the brain are full of blood, that organ being intensely congested. In some cases to such an extent has this been carried that the walls have given way. In these cases a clot of blood may be found pressing on the brain, and on account of this pressure the fatal result may have been brought about. There may also be an effusion of serous fluid either between the membranes of the brain, or within the ventricles.

It is difficult to say what is the cause of the disease. It is thought by some to be due to encephalic anæmia. On the other hand, the coma, delirium, and convulsions, are probably due to congestion of the brain and spinal cord. The removal of the offspring from the mother seems to bring on milk-fever, and hence it looks as if the presence in the blood of matters which ought to have been expelled from it by the medium of the milk has a great deal to do with the disease.

In regard to treatment, it may first be said that it is well to allow a cow to take a little gentle exercise during the few days before delivery is expected to take place, to avoid plethora, and perhaps to give a gentle cathartic draught. If called to a cow suffering from the early stages of the disease, the veterinarian will probably extract blood at this early stage, or not at all. In the case of a plethoric animal which has not fallen, bleeding may do good. In the first stages we may bleed, administer aperients and sedatives, and apply counter-irritation to the spine. Stimulants are very useful, and, as an example of these, we may mention sesquicarbonate of ammonium. Some persons advise persistent affusion of the spine with cold water, and will probably administer a full cathartic dose, at whatever stage they find the patient. A combination of sulphate of magnesium and solution

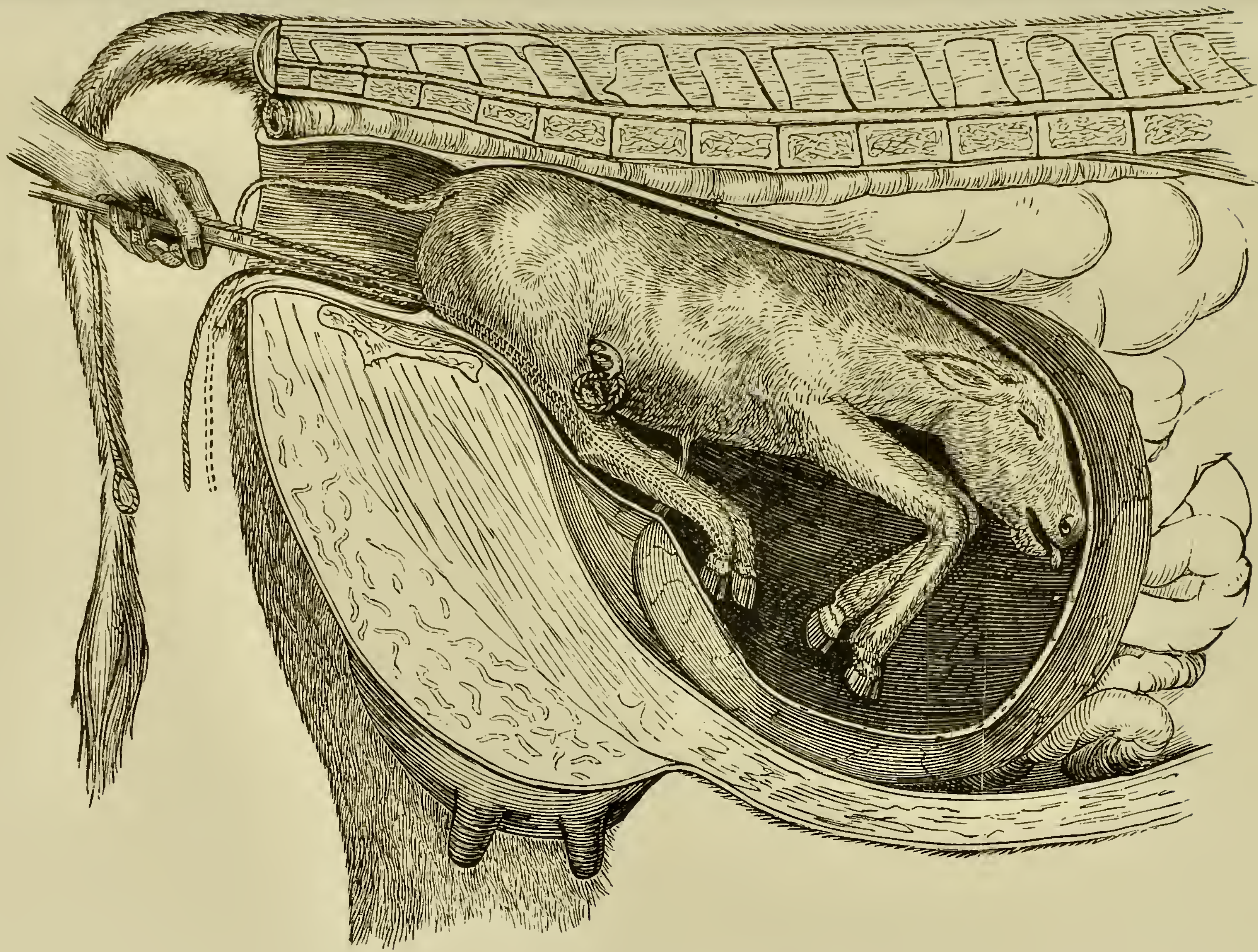


FIG. 92.
This picture is described under (*h*).

of aloes forms a useful cathartic mixture. The most assiduous care is requisite throughout the course of the malady. The suffering animal should be supported by bundles of straw, kept warm by being covered with clothes, the udder should be regularly stripped, and the body should be well rubbed. Ice-bags or cold water may be suitably applied to the forehead, and diffusible stimulants should be somewhat freely administered. A strong stimulating liniment should be rubbed along the spine. Enemas may be frequently given, and, moreover, the urine should be frequently drawn off by the aid of a catheter.

Medicines should be given by means of the stomach-pump, whereby the tympany will also be relieved. Gruel diet, or at any rate easily digestible laxative food, should be supplied. After recovery, the animal may still suffer from paraplegia, and if this is not amenable to the action of tonics, and the application of absorbent agents and blisters over the spine, the animal should be slaughtered and used for food, if the flesh is suitable for this purpose.

(1.) A dose of aperient medicine. Either (*a*) two pints of castor oil together with 20 drops of croton oil, or (*b*) 16 ounces of sulphate of magnesium together with half an ounce of powdered ginger and eight drachms of powdered aloes, to be given in a pint or more of warm water.

(2.) A stimulating draught (*a*) made up of four drachms of carbonate of ammonium together with one ounce of powdered ergot. This may be given in six fluid ounces of brandy or whisky every four hours. Or (*b*) a draught of one fluid ounce of aromatic spirit of ammonia together with three fluid ounces of spirit of nitric ether, to be repeated every half hour.

(3.) A liniment should be well rubbed along the spine now and again. It should be made of equal fluid parts of liniment of ammonia and of liniment of camphor.

(4.) The wet pack should be applied to the cow. It acts as an efficient sudorific, and the temperature may often be very greatly reduced by a careful and thorough application of it.

If the coma increases, whisky or brandy should be given in doses of about fifteen fluid ounces or a pint given at intervals of two hours; but if after the fourth dose no amelioration takes place, the case may be considered hopeless. Should the bowels be freely opened, and the animal gradually become more con-

scious, we may have some hope. After the turn, we may have recourse to mild tonics, good nursing, and generous but soft diet.

Our readers will understand that milk fever is to be distinguished from ordinary fever occurring after parturition, and called parturient fever; also from septic peritonitis, adynamia, and simple metritis. *Puerperal mania* may now and again occur a few days after parturition, being probably due to exposure, dyspepsia, and to removal of the calf from the cow. The animal is very excitable, champs with the jaws, gnaws at objects which may be near, and especially its own fore-legs. The careful administration of opiates is to be recommended in these cases.

MAMMITIS, OR INFLAMMATION OF THE UDDER, OR GARGET.

This disease is one which it is frequently difficult to treat, and it may supervene either shortly after calving or some time after. Moreover, the inflammation may either affect the whole udder or one or two only of the four quarters. In its ordinary form, garget consists in inflammation of a portion of the gland, together with heat, swelling, redness and pain. There may also be some febrile symptoms. If it is properly treated, the disease subsides, leaving no traces. The malady may also occur in a severe form, and the inflammation may go on to exudation or suppuration and the formation of abscesses. Even a large portion of the gland may become indurated, and suffer a permanent loss of secreting power. The malady may be brought about by blows, scratches, or other injuries, or it may apparently arise from the animal being unduly plethoric at the time of calving. Heifers are more especially liable to this complaint in a severe form, and hot summers are said to be an exciting cause. The udder becomes hot and hard, and much larger than is ordinarily the case. It is, moreover, red on the surface, and very tender and painful to the touch, and pain is occasioned if the animal moves. Frequently it may happen that lameness of one hind-leg may be one of the earliest symptoms of the disease, particularly if the inflammation has commenced in the body of the gland, and not in the teat. The pulse is quick and hard, the respirations are accelerated; in severe cases the chewing of the cud will be suspended, and the

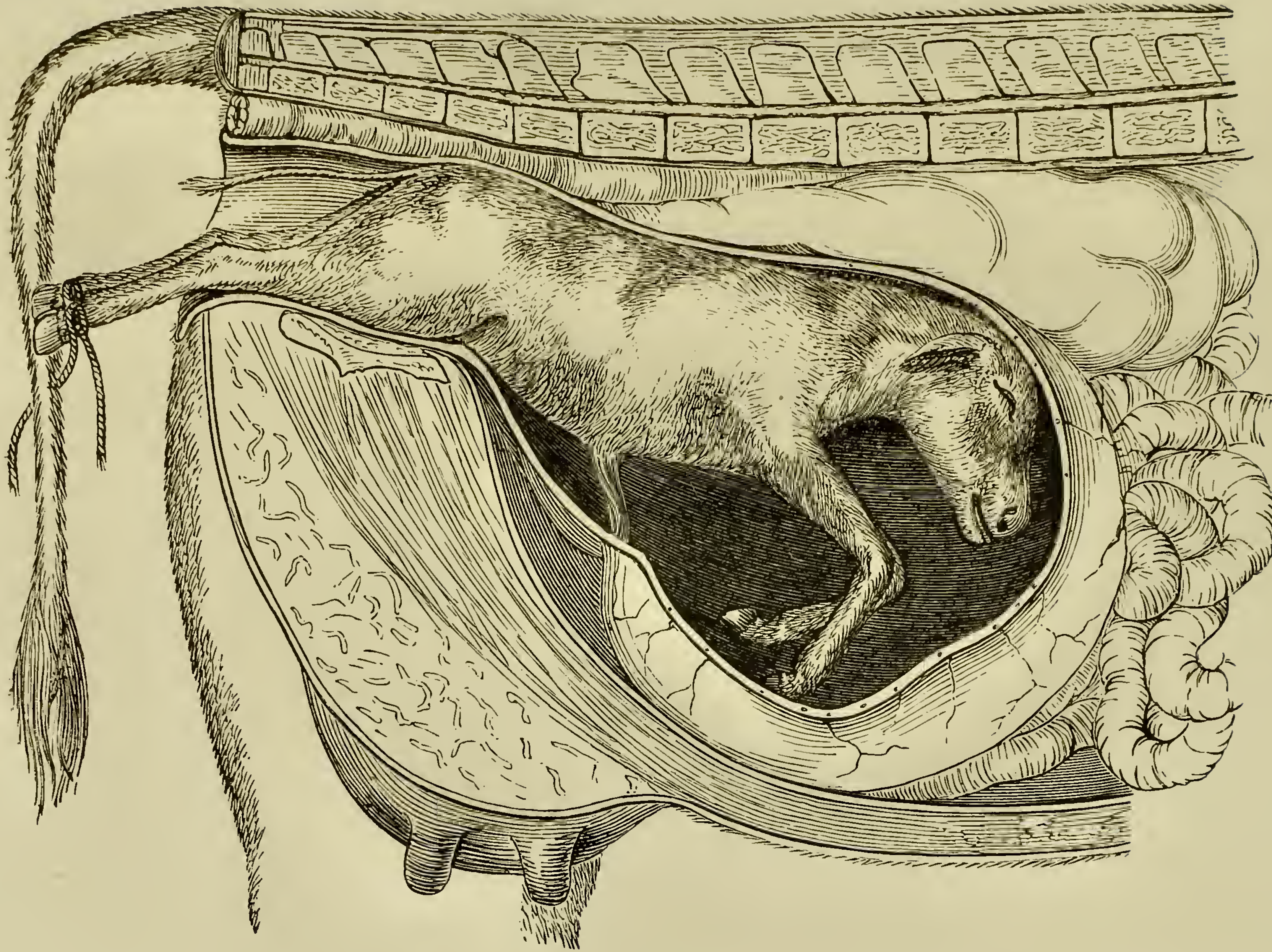


Fig. 93.

The above illustration is referred to under (*h*).

animal will refuse her food. If the cow is milked, a thin yellowish fluid is obtained, and in it small flocculi are contained. Later on, the milk becomes thick and very fetid, while the swollen udder enlarges, and becomes white here and there, abscesses being formed. These break and discharge, leaving deep and ragged ulcers which often burrow by means of sinuses into the deeper portions of the gland. Gangrene may next supervene, and large diseased parts of the gland may become separated, or require to be removed by the aid of the knife. At this stage, or before it, a fatal issue may occur.

Treatment should consist in the abstraction of blood and the administration of a cathartic dose. The udder should be fomented with warm water, and be kept free of milk, both by letting the calf suck and by regular drawing with the hand. Mr. Dobson recommended the following powder:—

Powered digitalis leaves ½ drachm, powdered tartarised antimony 2 drachms, powdered nitre ½ ounce. To be given once a day.

In the *Bovine Formulary* we recommend a draught made of one ounce of bicarbonate of potassium, and forty minims of tincture of aconite given in a sufficient quantity of water every four hours for a day, and then three times daily, so long as the temperature remains high.

Linseed poultices containing about four drachms of extract of belladonna may be applied. In cases of chronic induration, a lotion made up of one drachm of bicarbonate of potassium and one ounce of water may be injected, while at a later stage acetic liniment may be used. Also in chronic cases one ounce of bicarbonate of potassium, together with two drachms of iodide of potassium, may be given twice daily in a sufficiency of water. If an abscess form, it should be opened with a lancet, and the matter thereby set free. The wound may be dressed with the ointment of turpentine.

If mortification should ensue, powerful stimulants should be given, such as brandy, and the diseased parts of the udder must be cut away.

Sometimes the disease becomes chronic, the udder becoming hard. The compound iodine ointment will in these cases be found useful, and compounds of iodine may also be administered internally.

Injuries and Obstructions in the Teats.—There may be tumours in the teats of the size of a pea which may be felt by compressing the teat between the finger and thumb. There may, too, be lacteal calculi or milk-stones. A silver probe should be passed up the teat. A probe or knitting needle may also be frequently passed, in case there should be a stricture of the teat. Warts also are occasionally found at the end of a teat. They may be removed by means of a ligature of fine silk being tied firmly round, every day a new ligature being applied. This causes the warts to slough off. Sore or chapped teats are best treated by the application of the ointment of turpentine.

ABORTION.

When delivery takes place prematurely, abortion is said to have occurred. Dr. Fleming considers as cases of abortion all those instances in which expulsion is achieved thirty-five days before the normal period of about nine and a half months. It is apt to occur rather frequently in the case of the cow, and may happen at almost any period of pregnancy, the most usual time, however, being between the fourth and the seventh month. According to Earl Spencer, no calf can be born alive before the 220th nor after the 313th day, and it is impossible to rear calves born before the 242nd day. The general average is a period of about 270 days.

Abortion in cows, or premature expulsion of the fœtus, may be due to innumerable different causes; for instance, to all kinds of unsanitary conditions, to mechanical injuries, over-driving, innutritious and badly-prepared food, perhaps to certain kinds of fodder—*e.g.* to ergotised grain, to the administration of cathartics, as a consequence of exposure to cold, or of debility, or of tubercular affection of different organs, also in cases of hernia, or as a result of sympathy with other cows which have aborted near at hand. Occasionally it may seem to be epizoötic in character, entire herds and even the cattle of whole districts being affected.

There may be an incompatibility betwixt the fœtus and the dam either on the side of the dam or on that of the offspring. For example, there may be malformations, and, occasionally, injuries resulting from accidents. These might, perhaps, amount to

about five in a thousand. Amongst the chief and, perhaps, most preventable of the remaining causes are the imperfections in the character of the blood supplied to the offspring during its fœtal life, and those alterations of the nervous system of the mother which alter the calibre of the vessels supplied to the fœtus to such an extent as to cause an insufficient or intermittent blood-supply. No doubt the alterations in the blood-supply are due to some imperfection of diet, including both food and water. Again, virulent germs may be introduced from without, or diseased products may be elaborated within.

Abortion may also be brought about by a too sudden ingestion of rich food, by sudden alterations in the food-supply, by any cause which interferes with the assimilation of food, by a sudden change from rich to poor keep, or, on the contrary, from poor to rich food—as, for instance in spring-time, when the vegetation is luxuriant, or by the use of food which is too highly nitrogenised, whether artificial or natural. Again, in dry weather, the sources of water-supply may be dried up, or the water may be contaminated with sewage material, coming either from badly-managed drainage or more especially by the presence of decomposing carcases, blood, or other animal matter. A prominent cause of abortion is the ingestion of herbage grown under circumstances of excessive moisture in low-lying, damp, marshy, grounds, which thereby, perhaps, have a tendency to become ergotised. At any rate, some persons suppose that the growth of ergot near the seeds of grasses and cereals may be promoted by undue moisture and heat. Hence care should be taken during those seasons that the herbage is free from ergot, before it is supplied to animals. If there is much ergot in a pasture, all the cows in-calf should be taken off. It ought to be well known on every farm, as a rule, that the more naturally any animal is kept during its period of pregnancy, the less are the chances of it aborting. Moreover, at times, abortion may, so to say, assume an epizoötic form. This may possibly be brought about in some cases by unhealthy seasons, or it may, perhaps, be due to faulty management of the food-supply throughout a large number of animals. Instances, however, have been known when abortion has assumed a contagious character. This may, in our opinion, be explained on the theory that a specific fever of a mild character may be transmitted from dam to dam. This may be

so mild in its external symptoms as to escape ordinary observation, but at the same time of such a nature as to render the blood of the dam affected thereby antagonistic to the life of the offspring. One very marked cause of abortion in high-bred animals is the existence of tuberculosis, although this disease may not be so marked as to kill the animal affected by it. Careful management should be carried out, and advice should be sought from the veterinary surgeon. We may also mention close in-and-in breeding and the employment for too long a period of one bull in a herd. Where the season is the cause, preventive measures should be taken accordingly. If the season is dry, plenty of succulent food and bran-mashes may be allowed. If the season is too wet, then dry artificial food may be given. Supposing one animal has aborted, it should at once be most strictly isolated, and the fœtal membranes should be very carefully removed.

If abortion occurs at an early stage, it may be a matter of but small consequence, the symptoms being very similar to those of ordinary parturition. At a later date the act may be accompanied by some fever, a yellowish-red discharge, while the secretion of milk may be greatly impaired. It is, of course, very highly important that abortion should be put a stop to, so far as may be possible. Should the disorder break out from year to year, the food and water should be carefully examined, and the herbage may be searched for any poisonous plants. Any irregularity in the food-supply should be most carefully guarded against, and those cows which have aborted or are about to do so should be most scrupulously isolated. A gentle laxative, together with perfect quiet and careful attention to the animal's wants should be enjoined.

Sometimes stimulant tonics may be required. If the fœtal membranes are not passed, they should be removed as soon as possible. After a cow has once aborted, it is very liable to do so again, and hence it is often better to fatten the cow for sale. The byres, the clothes of the men in charge, and so on, should all be thoroughly disinfected. Any cause which seriously alters the state of a pregnant animal may bring about abortion. If the fœtus dies while in the uterus, it is best that abortion should take place, since otherwise the cow may go down with general blood-poisoning.

RETENTION OF THE PLACENTA OR AFTER-BIRTH.

This is very commonly attendant upon abortion, but it may also very often happen even after an otherwise normal delivery. Retention may be due to weakness on the part of the cow, while, on the other hand, an unduly energetic contraction of the uterus may also be a cause, the placental membrane becoming entangled in one of the horns of the uterus. Retention itself is not a matter of very great consequence, except in so far as the membranes are very liable to decompose; if so, the cow will suffer from blood-poisoning. In the general way, in ordinary cases of retention, a dose of cathartic medicine coupled with an aromatic will suffice, such, for instance, as a drench made up of fourteen ounces of Epsom salts, one ounce of powdered ginger, and one ounce of carraway seeds, to be given in about a pint of warm ale. If the placenta has been retained some time, as a consequence either of entanglement or of want of the necessary efforts at expulsion owing to weakness, it should be removed. Usually a slight recurrence of pains brings about expulsion. Traction may be applied by the medium of the protruding portion of the cord, the efforts made coinciding with the labour-pains, or, as we said previously, the projecting parts may be rolled round two pieces of stick. If these methods do not suffice, the hand should be introduced into the uterus, and the placenta should be carefully separated, any rough measures being strictly avoided. Each cotyledon should be separated from its place of attachment. If the membranes begin to decompose, there is a fetid discharge, and typhoid symptoms may be manifested. After the placenta has been removed, the uterus may be well washed out with chlorinated lime. Laxative medicines may be given internally, and the cow may be well supplied with good gruel. Occasionally severe fever may come on, the appetite be lost, the pulse become weak, quick, and well-nigh indistinct at the jaw, and a fetid discharge comes out of the vagina. At first there may be constipation, and, at a later stage, diarrhœa. Thick gruel, together with ale, should be given at short intervals, and, if necessary, also strong stimulants, such as brandy, spirits of nitre, and so on.

In cases of inversion of the urino-genital organs, the veterinarian should be sent for without delay.

INVERSION OF THE BLADDER

is not a very frequent occurrence in the cow, and is usually of a fatal character. The inverted bladder has the appearance of a tumour. On each side of it will be seen the termination of the ureters or canals which convey the urine from the kidneys to the bladder. From them the urine will be seen continually escaping. If the animal be seen at an early stage of this disorder, the bladder may be returned without much difficulty; but if it is impossible to return it, the animal should be slaughtered.

INVERSION OF THE VAGINA.

Inversion of the vagina generally occurs in debilitated animals and before parturition. The parts should be bathed with cold water; the inverted portion should then be carefully returned, and the truss applied and kept on the cow for the remaining time before parturition. A plentiful supply of food may be given.

INVERSION OF THE UTERUS.

Inversion of the uterus is very commonly met with in the cow. It is well to apply a truss to the cow immediately. It is necessary first to cleanse the organ well by removing all particles of dung, straw, &c., and then to carefully detach the after-birth. Then the uterus should be lifted into a clean cloth, and supported by a man on each side. Next, gentle and increasing pressure should be applied to the neck of the uterus, and then the fist should be applied to the *fundus* or lower part. If it is impossible to return the uterus when the cow remains standing, the operation may be greatly facilitated by turning the cow upon her back, and elevating the hind parts by means of pulleys. This position prevents any expulsive efforts on the part of the cow. A dose of opium may be given by the veterinarian after the organ has been returned, and a truss may at once be applied. The cow should be placed in such a position that her heels may be raised higher than her

head. This may be done by placing a much larger quantity of straw under her hind-feet than under her fore-feet.

Sometimes it may be necessary to ligature the neck of the uterus and cut off the remainder of the organ. The late Mr. D. Gresswell recorded cases of successful amputation of the uterus in the *Veterinary Record* for the year 1847.

DROPSY OF THE UTERUS.

Accumulations of fluid in the uterus of the cow are by no means uncommon. The cow looks as if she were in calf, and the disease may frequently be entirely overlooked. If an examination *per vaginam* be made, the womb will be found to be distended with fluid, from which, of course, fluctuation may be detected. The closed mouth of the uterus may be dilated with the finger.

THE SEASON OF INCREASE IN THE FLOCKS.

We read in *The Times* of January 9th, 1888, that in the Hampshire Downs lambing had become fairly general, and that on the farm of the College of Agriculture, at Downton, the first lamb was dropped on Christmas Day, while on January the 5th fifty ewes had yielded seventy-two lambs without any untoward results, and it was anticipated that by the 9th the first hundred lambs would have appeared, and would be enlivening the pen by their frolicsome gambols and tiny voices. This is fairly typical of the commencement of lambing on the hills and vales of Hampshire. Thus the season in the South of England opens well.

In these days of severe agricultural depression, preventable losses are of such great importance that farmers cannot be too careful, and they will feel the greater stimulus to adopt necessary precautions, when they reflect that the more earnestly they strive to carry out in practice the valuable hints which scientists are now enabled to give them in all the branches of the art of agriculture, the greater will be their gain. The outlook is favourable, good times, we believe, are at hand, and soon agriculturists will hold up their heads again as before, and, so far from being permanently damaged by recent adversity, will carry on with renewed energy the necessary and noble work on

which they are engaged, and on which the maintenance of the position and prestige of Great Britain so closely depends.

Some time ago one of the farmers in this district told us that last season he, finding that some turnips of his were unfortunately beginning to show signs of decay, removed his in-lamb ewes from off this particular field, and put them on another crop which was free from all signs of putrefaction. The result was that, although he of necessity lost money by this exchange, he really gained very greatly, for all his ewes did well, and he had no losses during the season. He had learnt by experience the wisdom of this course. There are, in short, very many little causes of a similarly removable kind in regard to which the very greatest care should be taken. It is often exceedingly puzzling to hear that Mr. X. nearly always or very often experiences very heavy losses indeed, while Mr. Y., whose farm adjoins Mr. X.'s, seldom or never meets with serious reverses of this kind. No doubt there may be accidental causes, such as bad water, ergotised grasses, faulty drainage, or so forth, all of which may have something to do with Mr. X.'s "bad luck"; but after a full inquiry it will very generally be found that there is some removable source of mischief to be discovered by careful scrutiny.

With regard to the evil effects of ergotised grasses, it is very difficult to form an absolutely decisive opinion; but our belief is that an excess of them is very mischievous indeed. Again, fields which are often run over by the hounds are not very suitable for in-lamb ewes. All these matters should be guarded against, for even if there be a slight expenditure at the outset, large gains may result in the long-run, if due precautions are taken.

At all times decaying vegetable matter is most unwholesome, and the bad effects which may arise from feeding sheep upon rotting turnips will naturally be most severe when the animals so kept are young or weak, or are ewes about to be engaged in the most serious and risky of all vital operations. Again, it is unwise to feed any animals upon one kind of food monotonously for long periods of time. This remark applies especially to the mistaken practice of keeping sheep on turnips too long. Change of food—for instance, from grass or seeds to turnips, or *vice versâ*—and, we may add, change of surroundings, are of far

more importance for all animals and also for human beings than is generally recognised. Sheep should have a fair amount of variation in regard to diet. It is not very unusual to see a flock of sheep in badly-drained fields that are but little better than sludgy mires owing to heavy showers. Paddling about, and feeding upon decaying vegetable matter, the sheep catch severe colds, even if they do not fall a prey to even worse disorders.

The faulty drainage of our fields in England is one of the most fruitful sources of disease in animals. It has been established beyond the possibility of doubt that this is so, and that some of the most virulent maladies may be brought about as a result of the decaying vegetable matter which generally lies stagnant upon such land. It is especially important to bear this fact in mind at all times, and particularly at the lambing season. Hence, when exceptional showers have produced temporary difficulties, the sheep should be removed to high and dry pastures. If kept on well-drained fields, sheep will do better; and it is, of course, especially necessary that in-lamb ewes should be provided with dry quarters.

If it were possible to estimate the wealth thrown away by reason of preventable losses among sheep even in the course of one year, many people would be very considerably astonished. We speak designedly of avoidable losses, for many sheep could be saved by the application of scientific principles and resources. During the last season many ewes were lost; but suppose we take the case of a farmer who had sixty ewes die, without adopting stringent measures of prevention. For the sake of argument we will roughly set down each animal's value at £2 10s., and we find that the total loss of this one gentleman would amount to £150. Now, how much of this comparatively large loss can be regarded as avoidable by the help of scientific methods? We may say that at least two-thirds of these ewes might have been saved, and hence the destruction of property valued at about £100 might have been prevented.

We can affirm definitely that the loss throughout the country—owing, it must be remembered, to a want of knowledge or of appreciation of the very simplest scientific results—must have been something excessive, something almost disastrous. It should also be borne in mind that the methods which science

would dictate in such cases are not difficult to learn nor to carry out. On the contrary, they are most easy and simple.

A case of septicæmia (blood-poisoning) breaks out among a number of lambing ewes. The shepherd, not knowing the danger, carries this dread disease from ewe to ewe by the medium of the contact of his hands or clothes. If, however, the ewe which was first attacked had been summarily isolated, and the shepherd had taken the greatest care to be thoroughly cleanly in regard to his clothes, and to wash his hands well in some good disinfecting preparation after tending any ewe which shows the slightest signs of disease, such as solution of permanganate of potassium, or a solution of carbolic acid of the proper strength (about 1 in 50), or even with such a readily procurable thing as carbolic acid soap, the danger would have been lessened, and the cases of disease far less numerous. If possible, this should be done after each case of any difficulty, and if any ewe shows signs of going wrong after lambing, that ewe should be kept from all possibility of contact with others. The shepherd cannot be too careful to maintain the most thorough cleanliness.

Many fatal cases are due to the fact that the ewes fall victims one after another to the above-mentioned dread malady known as "parturient septicæmia," which we may speak of in more popular phraseology as "blood-poisoning occurring in the stage which succeeds the delivery of the offspring." Now, how does this blood-poisoning arise? This question cannot be decided beyond all doubt; but it is probable that feeding beyond the requirements of healthy nutrition may be regarded as a predisposing cause. This at least is one view. It is a matter for no wonder that among a large flock of lambing ewes a case or two of this disease may occur. Farmers should therefore be prepared to find it breaking out occasionally, and they should be careful to instruct their shepherds how to act so as to prevent the spreading of the disease, which, if not properly checked, may communicate itself from ewe to ewe, as it were, with the rapidity of wildfire. The mother must possess the capability of making a due re-adjustment of vital processes, and also a most important re-arrangement of internal organs, and in any case these vital changes leave an animal for the time being weak, and for some time afterwards somewhat debilitated, and, consequently, liable to the attacks of disease.

Septicæmia, or blood-poisoning, is due to the existence in the blood of germs which are called the micrococci of septicæmia. As yet but little is known respecting these small vegetable growths, and as to the different kinds of them which occur in different kinds of animals; but that they grow and multiply in the blood, and choke up the blood-vessels, so that the nutrient fluid contained in them cannot perform its normal functions, has been clearly established.

In the process of giving birth to young, the surfaces are generally more or less lacerated, and in the weak state of the animal at the time, the process of healing and repair is not as rapid as it would be in an animal under ordinary circumstances. The germs, therefore, are quick to propagate themselves in the suitable nidus presented by the wounded and bleeding surfaces, which are naturally more or less exposed to the air after the expulsion of the young. Once having gained an entry into the blood, they have no great difficulty in growing and multiplying, and hence they soon swarm in the blood-vessels of the body, and from them are propagated to all parts. The impoverished cells of the blood and tissues cannot battle with them, as perhaps the active healthy cells of a normal animal might be able to do.

No doubt the disease is largely communicated either by the medium of the air, or by that of contact with infected ewes, or by the unsuspecting shepherd. He, all unconscious of what he is doing, conveys the disease from ewe to ewe, and, while tending the animals, supplies the dread cause of death by his hands and clothes. Doubtless this is a not unusual method of propagation. The diseased animal itself may also spread the contagion, and, therefore, in all cases those ewes which are attacked should be at once isolated, and removed to some distance from the rest of the flock. It is possible, too, that the germs may, when once they have entered into the system of the ewe, take on more virulent properties and more active powers—that the germs, in other words, may become more accustomed to living in the blood-vessels, and also be more readily conveyed by the medium of the air. If this is so, it is evidently the first step which tells, and hence the greater care should be taken to stamp out the disease, before it has had time to extend itself.

This "parturient septicæmia" is so fatal in its character that,

when once set up, it cannot be cured except by the most approved methods of treatment. It may be said that, with skilful management, treatment may be efficacious in about 50 per cent of cases; but it must be borne in mind that almost every day adds to the knowledge at the command of the specialist, and that possibly more favourable results might be hoped for. Unfortunately the veterinary surgeon seldom has a chance to display his skill. We cannot here say much of the treatment required except that the removal of all decomposing matter from the womb, and the local use of solution of permanganate of potassium, together with the internal administration of salicylate of sodium, suitable germicidal agents, and stimulants are indicated.

Another point of primary importance is that ill-compounded "lambing-oils" should on no account be used. Great mischief results from so doing, and we have no hesitation in saying that the disease may arise from this most needless cause. "Lambing-oils" consist sometimes of ingredients which by no possibility could be productive of good, while they often work a vast amount of harm. To be effective, they should be at once bland and mild, and at the same time antiseptic. It is probable that some of those which are used are not only not antiseptic, but are at the same time of a highly irritating and caustic nature. Hence, while they do not do the things they ought to do, they do effectually that which on no account they ought to do. Such preparations are therefore both worthless and mischievous. Even those which are in some degree antiseptic may be, owing to the inferior quality of the drugs they contain, or to the faulty mode of mixing, or to the wrong proportions in which they are compounded, harmful and dangerous.

In conclusion, then, we may point out that the cases we have drawn attention to furnish one instance out of many which might be adduced of the immense loss resulting to the farmer primarily, and to the country secondarily, by a want of knowledge and appreciation of well-known scientific principles. In these days especially, it is of paramount importance that no such avoidable diminution of wealth should be allowed to go on, unchecked by a few words of warning given in season. If all farmers would see that their shepherds exercise the necessary precautions, they would gain pounds and pounds by staying the progress of the fatal disease referred to.

It should be remembered that at breeding time an animal's constitution seems to be particularly susceptible to attacks of septicæmia or blood-poisoning, and this is true of all varieties of creatures. It is probable that the germ may be conveyed through the medium of the air; but there is no doubt that, whatsoever be the cause of its first appearance at any given time, it spreads with ease when once it has manifested itself in a flock.

We have said, then, that the food should not be unduly nutrient in character or amount, nor, on the other hand, should it be lacking in nourishing power, nor supplied in too small a quantity. There is manifestly always great danger in using decaying vegetable matter as food, and, though it certainly must seem very hard to have to lose an apparently valuable crop of turnips, as may occasionally happen, if our advice is carried out, or of rejecting a large number of them if they are being chopped up before use, it is at least better to submit to this loss than to have a large number of fatalities among the sheep.

Again, it is most important that all animals should have changes from time to time in their food supply. Men get very tired of the same food if it is repeated from day to day, and this is also true of animals. It is clear that any given source of nutriment must necessarily contain a maximum of particular ingredients and a scarcity or minimum of others; and a change of food-supply, provided always that it be of a suitable kind, very frequently seems to do a great deal of good.

If a case of illness breaks out among lambing ewes, the sufferers, or those which present the appearance of being attacked, should be at once isolated, and removed from all possibility of contact with the rest.

The shepherd and all who have to do with the sheep should always be most scrupulously cleanly, and should, when possible, wash his hands after attending to each case, in a solution of carbolic acid (1 in 50) or in a freshly-made solution of permanganate of potassium (about three grains or a little more to every ounce of water). He should, moreover, avoid noxious and strong preparations, which may work great damage, and would really do far better to use simple lard or vaseline, or some such mild and most valuable preparation as a weak ointment of boric acid. Any veterinary surgeon will be ready to supply mixtures

of the right kind, such as possess each of the two most necessary properties of being at once mild and antiseptic. The greatest care should be taken to obviate all risks of contagion from ewe to ewe.

We must, however, now return from our digression, and proceed to consider briefly the disorders connected with the generative system in sheep. Before we pass on, we here append the following table of numbers, which may be taken as fair averages :—

Animal.	Period of Gestation.	Respirations per Minute.	Pulse beats per minute.	Temperature.
Horse or Mare -	350 days.	9	36	99° F.
Ox or Cow - -	270 days.	15 to 50	54	101° F.
Sheep and Goat -	149½ days.	30 to 200	75	102½° F.
Pig - - - - -	115½ days.	15 to 25		103½° F.
Dog - - - -	62½ days.			100½° F.
Cat - - - - -	57 days.			
Rabbit - - - -	29 days.			

The only column connected with our present subject is that of the periods of gestation, and our readers will understand that the time occupied is liable to vary a great deal in different individuals, and also according to the breed, the sex of the offspring, and the age, strength, and condition of the mother. With regard to the question of premature delivery, we may say that it may be brought on by unwholesome food, such, for example, as fog grass or other kinds of coarse herbage, by corn, mouldy or over-ripened hay, frosted roots, too many early mangold-wurzels, or too great an abundance of roots of any kind, coupled with a deficiency of dry food, or, in short, by any food whatsoever which may be difficult of digestion. Of course, there are many other causes whereby premature delivery may be brought about. Of these we may mention bad water, fright, over-exertion, exposure, and so forth.

The influence of ergotised grass, in spite of all that has been written about it, cannot be said to be definitely cleared up. Speaking generally, we may suppose that some persons probably over-estimate, whilst others underrate, the influence exerted by

this substance. Moreover, there are some who think that ergot is not so greatly fraught with danger in the case of the ewe, as it seems to them to be in regard to the cow. An important point in this connection is that, as a matter of fact, ergot is only present on the grasses between the beginning of the month of August and the progress of the month of December, and during this period the greater number of the ewes have only been for a short time impregnated. Now it is known that ergot apparently has much greater power of bringing on abortion in proportion as the time is advanced towards delivery. Again, in the general way, ergot is only found in matured grass, and consequently for the most part sheep do not consume it, since they more especially feed upon the fresh and young herbage.

Another factor in the causation of abortion may be referred to. During long frosts, when there is no snow upon the ground, the ewes, being near their time, necessarily live in great measure on dry food, and at such times they drink freely. Unfortunately, it is much too frequently the case that the only source of water is a foul pond frozen over, but with a small hole broken through the ice for the purpose of allowing the sheep to drink. More than this, the water itself is often most unwholesome in consequence of the collection of the excrement of animals in it, and perhaps also as a result of the pond having been used for the reception of the bodies of animals which have died on the farm. We need scarcely dilate upon the utter and extreme folly of such actions as this ; and, indeed, no words can adequately express the reckless madness of thus poisoning the water supply.

Furthermore, the sheep, as we all know, is a very timid animal, and its nervous system is exceedingly liable to be upset by terror and fright. Hence it is of great importance that dogs should only be used with the utmost care. Indeed, except in such cases as the Downs of England or on the hills of Scotland, where they may be almost indispensable, it is really better not to use dogs at all in connection with in-lamb ewes. It is also to be remembered that foxhounds may work a great deal of damage, and that a pack of harriers is even still more dangerous in this respect. Consequently, if a farmer has any reasons to suppose that foxhounds or harriers may be expected, he should always take the precautionary measure of removing all of his

in-lamb ewes to secluded quarters, quite free from all possibility of close contiguity.

Once more, all over-exertion, as for example long journeys or rapid travelling, ought to be very stringently avoided in the case of in-lamb ewes. Indeed, for this reason it is better to purchase in-lamb ewes at home than at the market, for in this latter case it is very probable that some degree of over-exertion or abuse may have been undergone. The casting of ewes with the view of examining their condition ought to be put a stop to. Again, in driving ewes near their time of delivery, if the slightest signs of weakness are shown, they should be rested for as long a time as may be suitable or practicable.

Yet another factor in the causation of abortion is exposure. If a flock is pastured in a very exposed situation in winter time, when severe frosts, snowstorms, and tempestuous winds or rains are prevalent, miscarriages may be expected to occur. Moreover, in-lamb ewes ought not to be folded on roots; in the first place, because of the exposure thereby necessitated; secondly, because an abundance of roots is not suitable just before lambing; and last, but not least, because, when thus confined within a narrow space, sheep cannot take a sufficient amount of exercise. We need scarcely point out—for the advisability of such a course is very well known—how important it is that ewes which have aborted should at once be isolated apart from the rest of the flock, with the view of preventing all risk of infection. Further, it will be advisable to be very careful with in-lamb ewes at about the middle of the period of gestation, this being the time at which there is the greatest danger.

For some of the above hints on the subject of abortion we are indebted to Mr. John Walker's little book on *The Sheep and Lamb.*

After-pains in ewes may frequently be of a severe kind, and also attended with a fatal issue. This disorder is for the most part apparently due to the fact that the ewes afflicted with it have been fed too highly. To over-feed ewes at this critical period, is indeed a fatal error. No doubt in large measure the pain may be due to inflammation coming on in consequence of injuries received during delivery, or to the debilitated state of the body. A farmer, who had been allowing his flock an unlimited quantity of turnips on his best grass-land, having lost

eight of his finest ewes which had lambed and were lying dead in his folding yard, sought advice from Mr. Friend, who put a stop to the further ravages of the disease by having the rest of the flock removed to a bare pasture and administering oil and other medicines.

In many sheep-farming districts, especially in the South of England, great losses result from these so-called *heaving pains.* The chief symptom is straining of a violent kind. This complaint generally comes on in very plethoric ewes, just as parturient apoplexy does in plethoric cows, occurring especially in animals which are allowed rich artificial foods near the time of lambing, and frequently when the ewes have been kept pretty much on turnips. Again, it appears that salt, although it is good for animals in a low condition, is rather dangerous for very healthy or plethoric cattle or sheep. Sheep, when kept on turnips, do not take sufficient exercise, and a want of exercise, coupled with too much food, are causes very favourable to the development of parturient fever. It is frequently the case that ewes suffering from heaving pains are remarkable for having brought forth a great number of fine lambs, twins being numerous, and there being consequently a great supply of milk to the udder. On the Continent, sheep, which have not the same tendency to thrive rapidly and are not forced, are very seldom indeed afflicted with this disease.

It is usually at about the second or third day after yeaning that the affected ewes appear full and restless, have a staring look, pant, and strain. They discharge but little urine or feces. Moreover, the urine is very highly coloured and readily becomes ammoniacal. Febrile symptoms and violent heaving come on, and the animal soon becomes exhausted and dies. After death the uterus may be seen to be inflamed, ecchymosed, and possibly even gangrenous. The best natural preventives are exercise and low diet, and by way of medicine aperients and neutral salts may be tried. Clysters also may be given, and opiates injected into the womb, and an antiphlogistic course of treatment may be carried out.

The next disease we have to consider is that known under the name of Garget. When the lambs are sucking, ewes may display symptoms of pain and restlessness, and so great may be the distress occasioned, that they may perhaps not even allow

the lambs to suck at all. This inflammation of the udder is perhaps even more common in the ewe than in the cow. Probably the disorder may be in part brought on by the hardness or dryness of the soil, or by its being wet and dirty, and partly also by the vigorous bumps imparted by the head of the lamb. This malady, garget, may be particularly frequent and destructive in warm and damp seasons, when there is a great abundance of grass. In some cases the udder swells rapidly, develops hardened knobs, becomes greatly inflamed, and, unless the progress of the disease is arrested within twenty-four hours, the udder may mortify and the sheep die.

If an examination be made, one or both teats or the whole of the udder may be found to be red and enlarged and tender, and there may be several tumours on it. The best plan is to clear away the wool, and foment with warm water. A dose of Epsom salts, say about three or four ounces, should be given. A suitable ointment should also be rubbed on the udder, and the dose of salts may be repeated. If the udder enlarges continuously, and the heat and tenderness go on increasing, and the tumours become larger and more numerous, and some begin to soften, a deep incision should be made into that portion of the udder where the swellings are ripest, the matter pressed out, and the part well fomented with warm water. The ulcers or open tumours may be well bathed twice or thrice a day with a weak solution of chloride of lime or with some other disinfectant liquid, such as lotion of boric acid or of carbolic acid.

It is generally advisable to separate the lamb from the ewe, and sometimes it may be possible to put them together again in a few days' time. The above disease, it should be borne in mind, is liable to come on again, in a ewe which has once suffered, from it, and hence it is advisable that at some convenient time after recovery has taken place the ewe should be fattened with a view to slaughter.

CHAPTER VII.

THE BOVINE FORMULARY.

THE following index of diseases and prescriptions appropriate for them is written for oxen, and oxen only. However, in several cases different doses of the same remedies would be applicable in the case of sheep. As a rule, the differences in the actions of medicine on the two classes of animals, sheep and oxen respectively, is rather a question of relative quantity than of any other material point. Especially is this true, as is well known, in regard to medicines which act upon the circulatory, respiratory, and urinary systems. For example, the three drugs, aconite, digitalis, and nitre, bring about very similar effects in men, horses, dogs, and cattle.

As we have before pointed out, the special characteristics of the action of medicines in the case of cattle are mainly due to the peculiar construction of their digestive canal, and to their general phlegmatic constitution. In ruminants the stomach is divided into four cavities, is extensively lined with cuticular mucous membrane, and its first three compartments are less vascular and have a more mechanical function than has the corresponding part of the alimentary canal of men, dogs, or horses. Moreover, the rumen, and the manyplies always contain food, and frequently a large quantity of it. Consequently cattle require rather large doses of nearly all medicines, and especially of aperient medicines and of stimulants and tonics, in order to produce a due effect. Again, the kidneys and skin of cattle are

less easily acted on than the corresponding organs in horses. Now it is very important to remember that sheep are affected very much like cattle by most medicines. They generally take about one-fourth or one-fifth of the doses which are necessary for cattle. These animals may be backed into a corner, and the head should be held firmly between the knees, while the medicine is carefully administered. Great care is necessary in giving drenches to sheep, and also, of course, to oxen and any other animals. We may here repeat that all the prescriptions which follow are made up as for adult oxen, except in those cases in which the contrary is stated. If it is desired to find prescriptions for sheep, the body of the book must be searched ; or if the reader possesses the requisite special knowledge and skill, he may gather hints from the following formulæ. An adult sheep will usually take about one-fifth of the dose necessary for an ox. For lambs the dose is very much less. The younger the animal, the more easily is it affected by medicine, and hence the dose required must be smaller in proportion. According to Bourgelât, a one-year-old colt requires one-third the quantity of any medicine necessary for an adult horse, a two-year-old one-half, a three-year-old two-thirds. In the case of cattle, and especially in that of sheep, the dose ought to be relatively less than this.

One more remark we have to make before proceeding systematically, and that is that it must be understood than when more than one prescription is given under the same disease the different draughts are to be considered alternative. The reader will, after perusal, decide which mode of treatment he thinks best in any given case, or perhaps he may like to vary his treatment in accordance with the hints he may gather from a consideration of the various formulæ. When the contrary is the case, and two or more different draughts or therapeutic measures are requisite, the fact is stated. With regard to the letters V.P. whenever they are used, the reader will understand that *The Veterinary Pharmacopœia*, by Messrs. Gresswell, is referred to. For instance, tincture of aconite in that work is the same as that of the British Pharmacopœia, and is a very different tincture from that known as Fleming's tincture, which is, we believe, about five times as strong, and therefore requires to be used with the greatest possible care. In order to be on the safe

side in the case of dangerous drugs, it is always best to use the mildest preparations. We need not caution the skilled reader on such a point, but we may just say for the benefit of those who are not conversant with the technical names of preparations, that no one ought to prescribe without the aid of a Pharmacopœia by his side for reference. A British Pharmacopœia, or our Veterinary one will be found very useful. Even mistakes have arisen owing to persons making the error of thinking that spirit of chloroform is the same preparation as is chloroform itself, and other misapprehensions may assail the unpractised man, when he first begins to prescribe. Errors such as these could not possibly arise, if due care were taken. There is no science which requires greater judgment, care, and accuracy than that of prescribing for the numerous maladies to which animals are liable, except, indeed, that of human medicine, in which any mistake is fatal to the practitioner, and quite inexcusable and culpable. We may add that this Index is in some measure amplified by notes supplied by Mr. J. B. Gresswell, F.R.C.V.S., whose eminent position as a practising veterinary surgeon is well known and recognised.

ACTINOMYCOSIS.

(*a.*) *Local treatment.*

(i.) Mixture—

Iodine, one part.
Carbolic acid, four fluid parts.
Glycerine, four fluid parts.

After the affected part of the tongue has been carefully incised, this mixture may be applied by means of a brush to the sides of the indurated tumours which are present in the substance of the tongue. In the place of this mixture, simple tincture of iodine may be used, or it may be diluted, if it be thought necessary so to do, by adding to it an equal portion of spirit (methylated or otherwise). The tincture thus diluted is very useful for applying to the diseased parts of the tongue when that organ is sore and eroded.

(ii.) Gargle—

Acid solution of nitrate of mercury, eight minims.
Water, one ounce.

This gargle may be used for washing over the diseased tongue as an application, after the tumours have been cut into.

(*b.*) *Internal treatment.*

Draughts or powders known as *Tonics* may be beneficially administered when there is loss of appetite or emaciation, and they may be given once daily, or less frequently according to directions, and as may be deemed advisable.

ADYNAMIA NERVOSA GENERALIS, OR PRE-PARTURIENT ADYNAMIA.

Draught—

Solution of hydrochlorate of strychnine, two fluid drachms.
Tincture of perchloride of iron, half a fluid ounce.
Water to make eight fluid ounces in all.

This draught may be given twice daily; but it is very important to remember that in cases of pre-parturient adynamia it is advisable to commence treatment by the administration of a dose of laxative medicine. The formulæ mentioned under Cathartics (mild) are all useful ones.

AFTER-PAINS.

Draught—

Tincture of opium, one fluid ounce.
Spirit of chloroform, one fluid ounce.
Water to make one pint in all.

This draught may be given twice daily for a day or two, as may be judged necessary.

AGALACTIA, OR NON-SECRETION OF MILK.

Draught—

Powdered aniseeds, two ounces.
Powdered gentian, two ounces.

This draught may be mixed in a pint of warm water or beer, and administered twice or thrice daily. When the secretion of milk is stopped in the case of a cow presumably healthy in other respects, the diet should be of a nutritious kind, and supplied in full amount. It is, however, to be borne in mind that a cessation of the secretion of milk is very frequently merely one of the symptoms of some disease, and therefore in all cases great judgment is requisite, and the general disturbance must be most carefully looked to. Moreover, if the mammary gland is much wasted, treatment is not likely to be of any material value.

ALBUMINURIA.

Draught—

Sulphate of sodium, sixteen ounces.
Powdered caraway seeds, half an ounce.

This draught ought to be given as soon as possible, mixed with a pint of warm water or gruel, and it should be followed up with the administration of tonics, which may be given twice or thrice daily. Vegetable tonics are the most suitable.

AMAUROSIS.

When amaurosis is the result of loss of blood, any of the draughts mentioned below under the heading of Anæmia may be given with advantage.

ANÆMIA.

(i.) Draught—

Powdered gentian, one and a half ounces.
Powdered ginger, half an ounce.
Granulated sulphate of iron, two drachms.
Powdered nux vomica, forty grains.
Powdered capsicum, half a drachm.

This draught may be given twice daily in a pint of warm water, gruel, or ale, and it will prove to be an efficient hæmatinic and general tonic. If the bowels should be constipated, a laxative should be given.

(ii.) Draught—

Powdered gentian, one ounce.
Powdered ginger, half an ounce.
Carbonate of ammonium, half an ounce.
Carbonate of iron, two drachms.

This draught may be given twice daily in a pint of warm water, gruel, or ale.

(iii.) Draught.

Solution of hydrochlorate of strychnine, two fluid drachms.
Tincture of capsicum, four fluid drachms.
Tincture of perchloride of iron, one fluid ounce.

This draught is a very efficient one, and it should be given once daily in a pint of warm water or gruel.

ANÆSTHETICS.

(*a*) *General.*

Inhalation of chloroform.

From three to six fluid ounces (or even more) are usually required to occasion total anæsthesia in cattle. However, it is to be remembered that complete insensibility is not often necessary in the case of oxen, and indeed, partly owing to the difficulty with which these animals are brought under the influence of chloroform, and also partly on account of the rarity of important operations in cattle practice, it is not often necessary that anæsthesia should be brought about.

(*b*) *Local.*

Application of hydrochlorate of cocaine.

(i.) In the case of an operation on the eye.

Hydrochlorate of cocaine, two to four parts.
Water, one hundred fluid parts.

This solution is suitable for producing local anæsthesia before operating on the eye.

(ii.) In the case of an operation on any part other than the eye.

Hydrochlorate of cocaine, four to twenty parts.
Water, one hundred fluid parts.

A solution of this strength is required for producing local anæsthesia in parts other than the eye.

ANTHRAX.

(i.) Draught (antiseptic and antipyretic)—

Sulphite of sodium, three drachms.
Salicylate of sodium, three drachms.
Tincture of aconite (B. P.), forty minims.
Water, a sufficient quantity.

This draught may be given every four hours.

(ii.) Draught (antiseptic)—

Liquefied carbolic acid, thirty minims.
Gentian, two ounces.
Aniseed, two ounces.

This draught may be given every four hours mixed in a pint of water.

ANTISEPTICS.

(*a*) *Internal.*

(i.) Draught—

Sulphate of sodium, three drachms.
Salicylate of sodium, three drachms.
Water, a sufficient quantity.

(ii.) Draught—

Carbolic acid, one fluid drachm.
Glycerine, half a fluid ounce.
Mucilage of acacia, ten fluid ounces.

(*b*) *Local.*

(i.) Lotion—

Carbolic acid, one fluid part.
Water, twenty to thirty fluid parts.

(ii.) Lotion—

Boric acid, one part.
Hot water, twenty fluid parts.

(iii.) Lotion—

(1) Perchloride of mercury, one part.
Water, eight hundred fluid parts.

This weaker lotion is a useful antiseptic application for wounds.

(2) Perchloride of mercury, one part.
Water, five hundred fluid parts.

This stronger lotion is a useful antiseptic application for foul sores and ulcers, and for protuberant granulations from which a discharge flows. It is likewise destructive of pediculi and of the scab acarus, and not only kills the parasite itself, but also prevents the hatching of the eggs. When it is used in cases of ringworm, it destroys the vegetable fungus, and arrests the spreading of the growth. Great care is requisite, since this salt of mercury is exceedingly poisonous.

(iv.) Ointment—

Boric acid, one part.
Vaseline, three parts.
Lard, three parts.

This is a very useful and most valuable antiseptic ointment.

(v.) Ointment—

Iodoform, twenty grains.
Oil of eucalyptus, twenty minims.
Carbolic acid, twenty minims.
Lard or vaseline, one ounce and a half.

This is a very efficient antiseptic ointment for foul sores, discharging ulcers, or unhealthy surfaces.

(vi.) Ointment—

Carbolic acid, one part.
Lard or vaseline, thirty parts.

ANTIPYRETICS.

(i.) Draught—

Salicylate of sodium, four drachms.
Tincture of aconite (B. P.), thirty minims.
Spirit of nitrous ether, one fluid ounce.
Water, one half to one pint.

This draught may be repeated at intervals of four hours, if necessary.

(ii.) Draught—

Salicylic acid, three drachms.
Tinture of aconite (B. P.), forty minims.
Spirit of nitrous ether, one fluid ounce.
Water, one half pint to one pint.

This draught may be repeated at intervals of four hours, when necessary

ANTISPASMODICS.

(i.) Draught—

Oil of turpentine, one fluid ounce.
Tincture of opium, one fluid ounce.
Spirit of choloroform, half a fluid ounce.
Water to make a pint in all.

This draught may be administered without the water last mentioned in half a pint or a pint of thin gruel, and it may be repeated at intervals of three or four hours, if it is thought necessary.

(ii.) Draught—

Ether, two fluid ounces.
Spirit of chloroform, one fluid ounce.
Tincture of pimento, two fluid ounces.
Water, sufficient to make a pint in all.

This draught may be given without the water in a pint of thin gruel, and it may be repeated at intervals of three or four hours, if it is thought necessary. N.B.—It is not customary to give ether to cattle in those cases in which there is any great danger of a fatal result, and when the meat may be liable to be used for human food.

APERIENTS.

(i.) Sulphate of magnesium, twelve to sixteen ounces.
Powdered ginger, half an ounce.

This mixture may be given in a pint of warm water.

(ii.) Sulphate of sodium, sixteen ounces.
Powdered caraway seeds, half an ounce.

These two substances may be mixed together, and given in a pint of warm water; but this prescription is not as a rule quite so certain in its effects as is the preceding one.

(iii.) Castor oil, two pints.

APHTHA.

(*a.*) *Internal treatment.*

(i.) Draught—

Chlorate of potassium, four drachms.
Water, eight fluid ounces.

This draught may be given three or four times daily. It is well to commence the treatment in cases of aphtha with the administration of a good dose of aperient medicine.

(ii.) Draught—

Tincture of perchloride of iron, one fluid ounce.
Diluted hydrochloric acid, two fluid ounces.
Glycerine, half a fluid ounce.
Water, to make ten fluid ounces in all.

This draught may be given thrice daily.

(*b.*) *Local treatment.*

Gargles—

(i.) Boric acid, one part.
Glycerine, five fluid parts.
Water, eleven fluid parts.

This gargle may be used several times daily.

(ii.) Acid solution of nitrate of mercury, four minims.
Water, one fluid ounce.

This gargle likewise may be used several times daily.

(iii.) Permanganate of potassium, three to four grains.
Water, one fluid ounce.

This gargle also may be used twice or thrice daily.

APHTHA EPIZOÖTICA.

(*a*) *Internal treatment.*

(i.) Draught—
Salicylate of sodium, three drachms.
Spirit of nitrous ether, one fluid ounce.
Water, to make eight fluid ounces.

This draught may be given twice daily.

(ii.) Draught—
Sulphite of sodium, three drachms.
Water, to make eight fluid ounces in all.

This medicine may be given twice or thrice daily.

(iii.) Powder—
Sulphite of sodium, three drachms.
Aniseeds, one ounce.
Fenugreek, one ounce.

This powder may be administered in the food twice or thrice daily, when draughts are not given.

(*b.*) *Local treatment.*

Gargles—

Those which are above-mentioned under the heading of Aphtha may be used.

Ointment for the feet and teats. Either the ointment of boric acid, or that of carbolic acid, or that of iodoform, eucalyptus, or carbolic acid, will prove very useful. For the formulæ of these ointments either see Antiseptics or else refer to Gresswell's *Veterinary Pharmacopœia.* Either ointment may be applied once or twice daily. Ointment of boric acid, and that of salicylic acid, are most valuable preparations, and in many cases act almost like a magic charm.

APOPLEXY, PARTURIENT (PARTURIENT APOPLEXY).

(i.) Draught—
Carbonate of ammonium, four drachms.
Powdered ergot, one ounce.

This draught may be given, together with six fluid ounces of whisky or brandy, in a pint of warm water every four hours. Treatment should be commenced by the administration of an aperient (*see* Aperients).

(ii.) Hypodermic Injection—
Injectio ergotini hypodermica (B. P.), fifty to sixty minims.

The hypodermic injection of ergotin, of which the above doses are equivalent to twenty-five and fifty grains of ergotin respectively, may be employed when ergot is not administered with the stimulating draught above prescribed. It is to be borne in mind that the hypodermic injection of ergotin constitutes the most rapid and effectual method, whereby ergot can be introduced into the system. However, it is not always convenient to give it in this form.

(iii.) Liniment—

Liniment of ammonia, one fluid part.
Compound liniment of camphor, one fluid part.

This liniment may be rubbed on the spine, as often as may be deemed necessary or advisable. There is no doubt that the application of liniment to the back has a beneficial effect in cases of parturient apoplexy. It is better not to use liniment of belladonna, since it is liable to dry up the milk.

(iv.) Wet Pack—

The wet pack carefully applied to the cow acts as an efficient sudorific, and by the use of it the temperature may frequently be much reduced. This item of the treatment is one which should on no account be omitted except for some important reason, inasmuch as it does greatly enhance the value of the other remedial measures which are employed.

APOPLEXY, SPLENIC (SPLENIC APOPLEXY). *See* ANTHRAX.

ARSENICAL POISONING, when acute, may be treated as follows:—

Draught—

Hydrated sesquioxide of iron, four to six drachms.
Water, a sufficient quantity.

This draught may be repeated at intervals of three or four hours, until four or five doses have been taken in all. The hydrated sesquioxide of iron must be used freshly prepared.

ARTHRITIS, SCROFULOUS.

(i.) Draught—

Phosphate of calcium, four drachms.

This remedy may be given in a pint of water twice or thrice daily.

(ii.) Liniment—

Oil of turpentine, eight fluid ounces.
Strong solution of ammonia, three fluid ounces.
Soft soap, four ounces.

Digest, and then shake at intervals, and add water to make two quarts of liniment.

This liniment may be applied to the affected joints once or twice daily.

ASTRINGENTS.

(i.) Lotion—

Sulphate of copper, five drachms and twenty grains.
Water, eight fluid ounces.

This lotion may be employed as an application for ulcers and discharging sores.

(ii.) Ointment—

Oxide of zinc, one drachm.
Lard, one ounce.

This ointment may be used for the same purposes as the above lotion.

BITES AND STINGS (of bees, wasps, scorpions, &c.).

(i.) Lotion—

Carbolic acid, one fluid part.
Glycerine, one fluid part.

This lotion may be used as it is, or diluted with water. It may be very beneficial in causing subsidence of the swelling and irritation set up. Of

course great care will be necessary not to let the strong lotion come into contact with the flesh of the person using it. The liquefied carbolic acid of the V. P. may be used in its undiluted form as an application, or ammonia, or iodoform, may be employed. If the animal which has bitten the other be really rabid, other necessary precautions, such as strict isolation and slaughter, so soon as it may be possible, of both animals, ought to be carried out.

BLACK LEG, OR BLACK QUARTER.

(i.) Draught—

Sulphite of sodium, one drachm.
Salicylate of sodium, one drachm.
Water, a sufficient quantity.

This draught may be given every six hours.

(ii.) Preventive treatment—

Now, although some doubt may exist as to how the operation of setoning the dew-lap can be productive of benefit, no doubt can be entertained as to the fact of advantage being actually brought about by the setoning. As a matter of fact, setoning is frequently carried out, and it is certain that the operation is one of very great value. It may possibly be the case that the germs of the disease gain entrance into the system through the medium of the air, so that setoning is in reality tantamount to a mild inoculation. It is to be added that the setons ought to be dressed with the preparation known as black-oil, so valuable when properly made.

BLADDER, INFLAMMATION OF.

Draught—

Bicarbonate of potassium, one ounce.
Tincture of opium, one fluid ounce.
Tincture of aconite (B. P.), forty minims.
Water, a sufficiency.

This draught may be given thrice daily.

BLAIN. *See* GLOSSANTHRAX.

BLEEDING, OR HÆMORRHAGE.

(i.) Draught—

Tincture of perchloride of iron, one fluid ounce.
Diluted hydrochloric acid, four fluid drachms.
Glycerine, two fluid ounces.
Water, a sufficient quantity.

(ii.) Draught—

Powdered ergot, one ounce.
Powdered galls, two ounces.

The above two powders should be well mixed, and then added to a pint of warm water, and administered. The draught may be repeated at intervals, as may be deemed necessary.

(iii.) Hypodermic injection.

Injectio ergotini hypodermica (V. P., page 209, one fluid drachm).

(iv.) Local application—

Solution or tincture of perchloride of iron.

BLEEDING (POST-PARTUM).

(*a.*) *Internal treatment.*

(i.) Draught—

Powdered ergot, one to two ounces.

This powder may be given in a pint of warm water, and it may be repeated at intervals of one to two hours.

(ii.) Hypodermic injection—

Injectio ergotini hypodermica (V. P., p. 209), sixty minims.

This injection may be injected at intervals of one to two hours.

(*b.*) *Local treatment.*

As an injection into the uterus.

Tincture of perchloride of iron, one fluid part.
Water, four to nine fluid parts.

BLISTERS.

(i.) Blistering liniment—

Powdered cantharides, one ounce.
Olive oil, eight fluid ounces.

Digest over a hot bath.

(ii.) Absorbent blistering liniment—

Iodine, one ounce and a quarter.
Iodide of potassium, half an ounce.
Camphor, two drachms.
Methylated spirit, half a pint.

Apply this liniment to the part which it is required to blister, by the aid of a brush.

(iii.) Mustard liniment—

Mustard, four ounces.
Oil of turpentine, five fluid ounces.

Digest these two together for ten days, and then add a sufficient quantity of linseed oil.

(iv.) Blistering ointments—

(1.) Bromide of mercury, one pound.
Olive oil, one pint.

Mix well, and add seven pounds of melted lard.

(2.) Lard, four pounds.
Resin, four pounds.
Powdered cantharides, one pound.

(3.) Powdered cantharides, one part.
Venice turpentine, one part.
Resin, one part.
Palm oil or lard, four parts.

BLOODY FLUX, OR DYSENTERY.

Draught—

Ipecacuanha, half an ounce.
Powdered opium, two drachms.
Chalk, two ounces.
Galls, two ounces.

This draught may be given in a pint of warm water thrice daily.

BLOWN. *See* TYMPANITES.

BOWELS, INFLAMMATION OF.

Draught—

Tincture of opium, two fluid ounces.
Tincture of aconite (V. P.), forty minims.

This draught may be repeated at intervals of three or four hours.

BRAIN, INFLAMMATION OF.

(i.) Draught—

Hydrate of chloral, three drachms.
Bromide of potassium, three drachms.
Water, a sufficient quantity.

This draught may be administered thrice daily. It is advisable to commence treatment with the administration of a powerful cathartic.

(ii.) Blister.

Ointment of cantharides, *see* COUNTER-IRRITANTS.

This ointment may be applied to the poll.

BRONCHITIS, ACUTE.

(*a.*) *In early stage.* A cathartic should be given.

Draught—

Extract of belladonna, two drachms.
Solution of acetate of ammonium, four fluid ounces.
Water, a sufficient quantity.

This draught may be given thrice daily.

(*b.*) *In later stage.*

(i.) Draught—

Carbonate of ammonium, three drachms.
Solution of hydrochlorate of strychnine, two fluid drachms.
Spirit of nitrous ether, one fluid ounce.
Water, a sufficient quantity.

This draught may be given twice daily.

(ii.) Counter-irritants, *see* Counter-irritants.

Blisters may be applied locally at the outset of the disease.

BRONCHITIS, CHRONIC.

Draught—

Carbonate of ammonium, three drachms.
Liquor strychninæ hydrochloratis, two fluid drachms.
Spirit of chloroform, half a fluid ounce.
Water, a sufficient quantity.

This draught may be administered twice daily.

BRONCHITIS, VERMINOUS; OR HUSK, OR HOOSE.

In this complaint the draughts mentioned under the heading of Anæmia may be administered. It is essential that animals suffering from this disorder should be removed to fresh pastures, and that their food-supply should be nutritious in quality and plentiful in amount. With regard to preventive measures, it is very necessary that contaminated pastures should be avoided, especially about July, August, and September, in which months the disease is acquired, and it is also advisable that the affected animals should be isolated from those which are healthy. Moreover, rock-salt should be provided.

We may here mention one method of treatment in the case of sheep, as well as oxen, afflicted with Verminous Bronchitis, it being understood that the rest of the curative measures mentioned below are, as usual, those applicable to oxen. It is, however, necessary that very great care should be exercised in the process, lest the sheep should inhale too much of the dioxide of sulphur which is set free. A small room or shed is to be filled with the fumes of burning sulphur by placing sulphur in a suitable vessel properly protected from being overturned, and setting fire to the sulphur. It will not be long before the room is full of the gas, and then the affected sheep may be made to pass through this room, one after the other. Thus, for the few moments occupied in passing through the room, the sheep will breathe the gas, which will thus come into contact with the worms. We scarcely need say how important it is that the sheep should not be allowed to remain in longer than a few moments, for fear lest they should be choked. It will be well to try how this method answers with about half-a-dozen animals before extending it to all the flock or herd. Moreover, it may probably be thought well to carry out this treatment again after an interval of a few days or so.

(i.) Draught—

Oil of turpentine, one fluid ounce.
Linseed oil, nine fluid ounces.

This draught may be administered once or twice daily.

(ii.) Intra-tracheal Injection—

Oil of turpentine, two fluid drachms.
Carbolic acid, twenty minims.
Tincture of opium, one fluid drachm.

Half a drachm of chloroform, instead of the tincture of opium, has been recommended (Penhale).

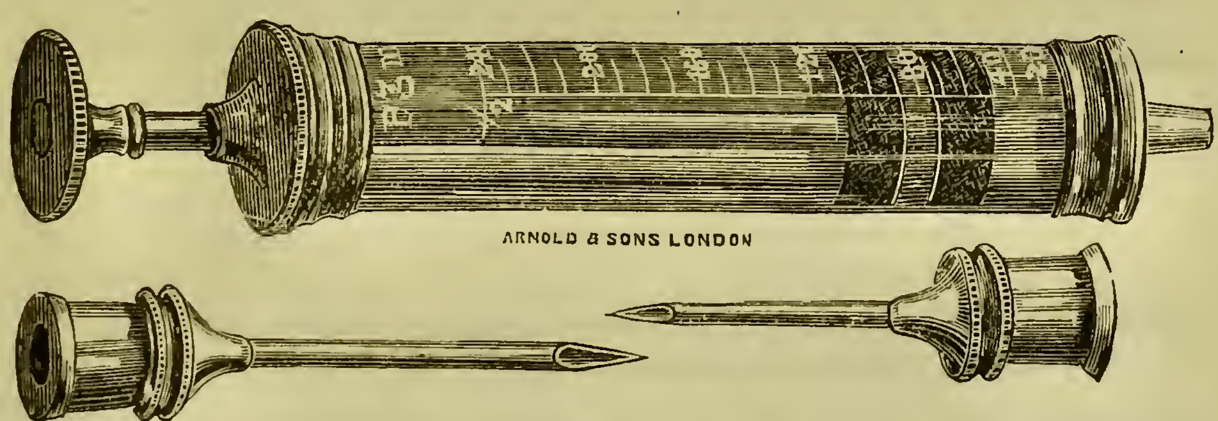


FIG. 94.—INTRA-TRACHEAL SYRINGE.

(iii.) Fumigations—

Fumigations may possibly be of some little value in the treatment of Verminous Bronchitis. Those which have been tried are (1) the fumes of burning sulphur, (2) chlorine gas, (3) carbolic acid in the form of vapour.

BRONCHO-PNEUMONIA.

(*a.*) *In early stage.*

Draught—

Extract of belladonna, two drachms.
Carbonate of ammonium, three drachms.
Solution of acetate of ammonium, four fluid ounces.
Water, a sufficient quantity.

This draught may be given thrice daily.

(*b.*) *In later stage.*

(i.) Draught—

Carbonate of ammonium, three drachms.
Solution of hydrochlorate of strychnine, two fluid drachms
Spirit of nitrous ether, one fluid ounce.
Water, a sufficient quantity.

This draught may be administered twice daily.

(ii.) Counter-irritants or blisters may be applied at the outset of the disease, as in the case of acute bronchitis.

BURNS.

Local application—

Solution of lime, one fluid part.
Olive oil, one fluid part.

BURSAL ENLARGEMENTS.

Ointment—

Biniodide of mercury, one pound.
Olive oil, one pint.

Mix well, and add seven pounds of melted lard.

CACHEXIA. OSTEO-MALACIA.

Draught—

Phosphate of lime, four drachms.
Sulphate of iron, two drachms.
Gentian or calumba, to make three ounces in all.

This medicine may be administered in a pint of water twice daily.

CARBUNCLE.

Draught—

Powdered nux vomica, forty grains.
Carbonate of ammonium, two drachms.
Carbonate of iron, two drachms.
Gentian, one ounce.

This mixture may be mixed with a pint of water, and given twice daily.

Local application, *see* ANTISEPTICS.

CATARRH.

Draught—

Solution of acetate of ammonium, four fluid ounces.
Bicarbonate of potassium, one ounce.
Spirit of chloroform, half a fluid ounce.
Water, a sufficient quantity.

This draught may be given twice or thrice daily.

CATARRH, MALIGNANT.

(i.) Draught—

Tincture of perchloride of iron, one fluid ounce.
Salicine, one drachm.
Simple syrup, four fluid ounces.
Water, a sufficient quantity.

This draught may be given thrice daily

(ii.) Gargles—

(i.) Acid solution of nitrate of mercury, six minims.
Water, one fluid ounce.

(ii.) Permanganate of potassium, three to four grains.
Water, one fluid ounce.

CATHARTICS.

(a.) *Mild.*

(i.) Sulphate of magnesium, twelve to sixteen ounces.
Powdered ginger, half an ounce.

These drugs may be mixed in a pint of warm water, and then administered.

(ii.) Sulphate of sodium, sixteen ounces.
Powdered caraway-seeds, half an ounce.

These drugs may be mixed with a pint of warm water, and then administered; but this prescription is, as a rule, not so certain in its effects as is the preceding one.

(iii.) Castor oil, two pints.

(b.) *Strong.*

(i.) Sulphate of magnesium, sixteen ounces.
Powdered aloes, eight drachms.
Powdered ginger, half an ounce.

The above ingredients should be mixed, and given in a pint or more of warm water.

(ii.) Castor oil, two pints.
Croton oil, half a fluid drachm.

(iii.) Gamboge, half an ounce.
Aloes, half an ounce.
Ginger, half an ounce.
Powdered croton bean, one drachm.

These substances may be well mixed, and given in a pint of warm water.

(c.) *Very strong.*

Intravenous injection of sulphate of eserine.

The salt known as sulphate of eserine in a dose of one grain to one grain and a half dissolved in water may be injected intravenously in cases of very protracted constipation. It is, however, necessary to use this method of treatment with the very greatest care, and only in cases which would otherwise prove unmanageable. One great disadvantage of this treatment is that if the animal should die after it has been carried out, the flesh is not fit for human food.

CATTLE-PLAGUE.

Treatment of cattle-plague is not carried out, the affected animals being slaughtered, with due antiseptic precautions, in accordance with the wise provisions of the Act of Parliament relating thereto. Should this dreadful scourge again make its appearance in England, it would be requisite to stamp it out at once with a firm hand.

CHARBON. *See* ANTHRAX.

Unfortunately anthrax makes its appearance far too frequently among oxen. It is a malady which also should be stamped out at once by slaughter of all affected animals, and subsequent burial of the carcases with antiseptic precautions.

CHINE-FELON, OR LUMBAGO. *See* FELON, CHINE-, OR LUMBAGO.

CLEANSING MEDICINE.

Draught—

Sulphate of magnesium, sixteen ounces.
Powdered ergot, one ounce.
Carbonate of ammonium, four drachms.

This draught may be administered in two pints of warm water, and if it is deemed necessary to do so, repeated on the following day.

COLCHICUM-POISONING.

Draught—

Solution of ammonia, two fluid ounces.
Brandy or whisky, four fluid ounces.

This draught may be administered every four hours for three or four times in succession, in a pint of gruel or mucilage of linseed.

COLIC, FLATULENT.

(i.) Draught.

Solution of ammonia, one fluid ounce.
Spirit of chloroform, one fluid ounce.
Water, a sufficient quantity.

This draught may be administered at intervals of four hours. Treatment should be commenced with a full dose of aperient medicine.

(ii.) Draught—

Hyposulphite of sodium, four drachms.
Water, a sufficient quantity.

This draught may be administered at intervals of four hours. Sixteen ounces of sulphate of magnesium may be given with the first dose of this drench.

COLIC, SIMPLE.

Draught—

Oil of turpentine, half a fluid ounce.
Tincture of opium, one fluid ounce and a half.
Spirit of nitrous ether, two fluid ounces.

This draught may be given at intervals of three or four hours.

COLLAPSE.

Whisky, six fluid ounces.
Solution of ammonia, one fluid ounce.

This draught should be mixed with a pint of gruel or of water, and then administered.

CONDITION POWDER.

Fenugreek, seven parts.
Aniseeds, three parts.
Cummin-seeds, three parts.
Ginger, one part.
Carbonate of iron, one part.
Milk of sulphur, one part.

The dose of this mixture is about two to four ounces.

CONGESTION OF THE LIVER.

(i.) Draught—

Sulphate of sodium, sixteen ounces.
Aloes, four drachms.

This draught should be mixed with a pint of warm water and given, and it should be followed by the administration, twice daily, of the following:—

(ii.) Draught—

Chloride of ammonium, four drachms.
Spirit of nitrous ether, two fluid ounces.

This draught should be mixed in a pint of thin gruel and given twice daily.

CONJUNCTIVITIS.

(i.) Lotion—Application to parts around the eye.

Boric acid, three grains.
Tincture of opium, ten minims.
Water, one fluid ounce.

(ii.) Lotion—Application to the eyeball.

Sulphate of atropine, two grains.
Water, one fluid ounce.

CONSTIPATION. *See* CATHARTICS.

COOLING LOTIONS.

(i.) Draught—

Solution of sub-acetate of lead, one fluid part.
Tincture of arnica, one fluid part.
Water, eight fluid parts.

(ii.) Draught—

Chloride of ammonium, two ounces
Nitrate of potassium, two ounces.
Water, sixteen fluid ounces.

CORNEA, INFLAMMATION OF.

Lotion—

Sulphate of atropine, two to four grains.
Water, one fluid ounce.

A few drops of this lotion should be placed in the corner of the eye.

CORNEA, OPACITY OF.

Nitrate of silver.

COUGH.

Draught—

Powdered digitalis, one drachm.
Liquor ammonii acetatis, four fluid ounces
Spirit of nitrous ether, two fluid ounces.
Extract of belladonna, two drachms.
Water, a sufficient quantity.

This draught may be given twice daily.

COUNTER-IRRITANTS.

(i.) White liniment—

Oil of turpentine, eight fluid ounces.
Strong solution of ammonia, three fluid ounces.
Soft soap, four ounces.

Shake these well together, and then add, shaking at intervals, water to make two quarts of liniment.

(ii.) White liniment—

Proof spirit, two pints.
Strong solution of ammonia, half a pint.
Soft soap, four ounces.
Camphor, one ounce.

(iii.) Acetic white liniment—

Eggs, four.
Acetic acid, four fluid ounces.
Solution of acetate of lead, four fluid ounces.
Oil of rosemary, half a fluid ounce.
Oil of turpentine, eight fluid ounces.
Water, to make two quarts in all.

(iv.) Absorbent liniment—

Acetic white liniment, eight fluid ounces.
Solution of iodide of potassium, two fluid ounces.

(v.) Compound camphor liniment—

Camphor, five parts.
Oil of lavender, one quarter of a fluid part.
Strong solution of ammonia, ten fluid parts.
Methylated spirit, thirty fluid parts.

Dissolve the oil and the camphor in the spirit, and then add the ammonia gradually.

(vi.) Mercurial liniment (for enlarged glands)—

Ointment of mercury, two ounces.
Camphor, one drachm.
Oil of tar, four fluid ounces.
Linseed oil, four fluid ounces.

(vii.) Blistering liniment—

Powdered cantharides, one ounce.
Olive oil, eight fluid ounces.

Digest these two over a hot bath.

(viii.) Absorbent blistering liniment—

Iodine, one ounce and a quarter.
Iodide of potassium, half an ounce.
Camphor, two drachms.
Methylated spirit, half a pint.

Paint the part required to be blistered with this liniment by means of a brush.

(ix.) Mustard liniment—

Mustard, four ounces.
Oil of turpentine, five fluid ounces.

Digest for a period of ten days, and then add a sufficient quantity of linseed oil.

(x.) (1.) Blistering ointment—

Biniodide of mercury, one pound.
Olive oil, one pint.

Mix well, and add seven pounds of melted lard.

(2.) Blistering ointment—

Lard, four pounds.
Resin, four pounds.
Powdered cantharides, one pound.

(3.) Blistering ointment—

Powdered cantharides, one part.
Venice turpentine, one part.
Resin, one part.
Palm oil or lard, four parts.

DIABETES INSIPIDUS.

Draughts.

The same draughts should be given as those which are prescribed for anæmia. However, it is to be remembered that diabetes insipidus is not commonly met with in the bovine species. In cases of diabetes insipidus the diet should be nutritious and liberal in amount, and in the first instance laxatives should be administered.

DIAPHORETICS.

(i.) Draught—

Solution of acetate of ammonium, four fluid ounces.
Camphor, two drachms.
Spirit of nitrous ether, one fluid ounce.

This draught should be given in a pint of warm gruel.

(ii.) Wet pack.

This is very efficient as a diaphoretic in the case of cattle, and it is especially recommended as an item of treatment in cases of parturient apoplexy.

DIARRHŒA.

(*a.*) *In adults.*

(i.) Draught—

Powdered opium, two drachms.
Catechu, two drachms.
Galls, two drachms.
Prepared chalk, one ounce.

This draught may be given in a pint of warm water twice daily.

(ii.) Draught—

Catechu, two drachms.
Camphor, two drachms.
Powdered bael fruit, two ounces.
Powdered opium, two drachms.
Mucilage of starch, one pint.

This draught may be given twice daily.

(*b.*) *In calves.*

(i.) Draught—

Pepsine, twenty grains.
Diluted hydrochloric acid, thirty minims.
Sulphate of cinchonine, seven and a half grains.
Water, a sufficient amount.

This draught may be given twice or thrice daily in a sufficient quantity of water or mucilage of starch.

(ii.) Draught—

Diluted sulphuric acid, thirty minims.
Tincture of catechu, two fluid drachms.
Spirit of chloroform, thirty minims.
Water, a sufficient quantity.

This draught may be given three or four times daily in water or mucilage of starch. Perhaps the most valuable of all remedies for cases of diarrhœa in calves is salicylate of bismuth in two drachm doses. In the *Veterinary Journal* of November 1886 we also recommend salicylate of iron in cases of diarrhœa among calves.

DISINFECTANTS.

The disinfectants most usually employed for purifying cattle-sheds, houses, and all other places which require to be disinfected, are carbolic acid, chloride of lime, chlorine gas, and last, but far from least, sulphurous anhydride. This last-mentioned gas has a perfectly marvellous effect. Undoubtedly, if we take everything into consideration, sulphur dioxide is the handiest and best disinfectant known. It is so easy to manufacture and to use, and if the most ordinary precautions are taken, no bad result can possibly accrue. In short, we can, from very long-continued personal experience, most emphatically and positively assert that the fumes given off from burning sulphur constitute one of the very best disinfecting agents known. There are different ways of employing this gas. Perhaps one of the best methods is that described on page 49 of the *Veterinary Pharmacopœia* (Gresswell's); but a very simple way is that of leaving a tray containing burning coals in the room which it is required to disinfect, and sprinkling the sulphur upon the coals. The assistant or person who carries this out should take care not to inhale too much of the vapour. It is, moreover, to be borne in mind that sulphur dioxide gas is almost as valuable as a disinfecting agent in human diseases as it is in regard to those of lower animals.

Under the heading of Verminous Bronchitis, we mentioned a way of treating that complaint by allowing the animals affected with it to pass through a room containing the fumes of burning sulphur. It is to be also borne in mind that the inhalation of the fumes of burning sulphur is a very efficient preventive and curative agent in the case of many infectious maladies of animals and man, and of these we may here mention swine fever of pigs, anthrax of cattle and sheep, and possibly small-pox of man. We must repeat, however, that great care is requisite in carrying out this measure.

DOWNFALL OF THE UDDER. *See* GARGET.

DROPSY, OR ASCITES.

Draught—

Nitrate of potassium, two drachms.
Bicarbonate of potassium, four drachms.
Oil of juniper, one fluid drachm.
Spirit of nitrous ether, one fluid ounce.
Water, a sufficient quantity.

Animals afflicted with dropsy can only be cured with great difficulty. Those drenches which are recommended under anæmia are frequently very efficacious.

DYSENTERY.

Draught—

Ipecacuanha, half an ounce.
Powdered opium, two drachms.
Chalk, two ounces.
Galls, two ounces.

These substances may be well mixed together, and, with a pint of warm water or gruel, given thrice daily, until a cure is effected.

DYSURIA.

Draught—

Nitrate of potassium, one ounce.
Bicarbonate of potassium, one ounce
Water, a sufficient quantity.

This draught may be administered twice daily.

ECBOLICS.

(i.) Powdered ergot, one ounce in water.
(ii.) Tincture of ergot, one fluid ounce.
(iii.) Liquid extract of ergot, one fluid ounce.

ECZEMA CONTAGIOSA, OR E. EPIZOÖTICA. *See* APHTHA EPIZOÖTICA.

EMPHYSEMA.

As a rule, oxen suffering from emphysema are killed. If, however, the animals are to be treated, the same remedies may be given as those which are mentioned under the heading of Anæmia.

EPISTAXIS.

(i.) Draught—

Tincture of perchloride of iron, one and a half fluid ounces.
Tincture of ergot, one fluid ounce.
Water, a sufficient quantity.

(ii.) Draught—

Sulphate of iron, two drachms.
Powdered ergot, one ounce.
Water, a sufficient quantity.

ERYSIPELAS.

(i.) Draught—

Tincture of perchloride of iron, one and a half fluid ounce.
Spirit of chloroform, half a fluid ounce.
Water, a sufficient quantity.

This draught may be given at intervals of four hours.

(ii.) Draught—

Tincture of aconite (V. P.), forty minims.
Chlorate of potassium, three drachms.
Water, a sufficient quantity.

This draught may be given at intervals of six hours.

ERYTHEMA CHRONICA.

Draught—

Liquor arsenicalis, three fluid drachms.
Bicarbonate of potassium, one ounce.
Water, a pint.

This draught may be given twice daily after food. The treatment of chronic erythema should be commenced by the administration of a laxative.

ERYTHEMA MAMMILLARUM. (*See* Scarlet Fever, p. 329, &c.)

When this affection breaks out, it is necessary to remove the calf, and to apply boric acid lotion locally. In the first instance, a laxative draught should be administered. The following ointment will be found to be highly efficient, especially in cases when the pain and the inflammation are considerable.

Ointment—

Extract of belladonna, one part.
Boric acid, two parts.
Carbolic acid, half a fluid part.
Benzoated lard, thirteen parts.

Some persons might prefer the ordinary ointment of boric acid, as it is, perhaps, equally effectual and made very simply, viz., as follows:—Melt four parts of soft paraffin and two parts of hard paraffin together, and add one part of boric acid in fine powder, distributing it over the surface of the liquid by passing it through a sieve. Then stir the mixture constantly until it is cold.

EYE.

(*a.*) *Contractor of Pupil of.*

Lotion—

Sulphate or salicylate of eserine, one to two grains.
Water, one fluid ounce.

(*b.*) *Dilator of Pupil of.*

Lotion—

Sulphate of atropine, two to four grains.
Water, one fluid ounce.

FALLING OF THE WOMB.

Draught—

Tincture of opium, two fluid ounces.
Spirit of chloroform, one fluid ounce.
Water, a sufficient quantity.

This draught may be given once or twice. The womb should be dressed with antiseptic lotion, and replaced before the medicine is given.

FELON, CHINE-, OR LUMBAGO.

(i.) Draught—

Carbonate of ammonium, two drachms
Bicarbonate of potassium, one ounce.
Gentian, one ounce.
Ginger, one ounce.

These substances may be mixed up with a pint of warm water, and administered twice daily.

(ii.) Liniment—

Liniment of belladonna, one fluid part.
Compound liniment of ammonia, one fluid part.

FEVER, PARTURIENT. *See* PARTURIENT SEPTICÆMIA.

FOOT AND MOUTH DISEASE. *See* APHTHA EPIZOÖTICA.

FOUL IN THE FOOT.

All the diseased horny tissues should be most carefully cleansed and removed, especially those parts which are under-run with matter, or near which there has been a formation of matter. They should also be poulticed with linseed. Furthermore, it is advisable to administer a cathartic, and also to dress the foot with one of the following preparations :—

(i.) Ointment—

Carbolic acid, four fluid drachms.
Lard, four ounces.

(ii.) Ointment—

Boric acid, one part.
Lard, seven parts.

(iii.) Powder—

Sulphate of copper, finely powdered, one part.
Alum, finely powdered, one part.

(iv.) Local application—

Nitrate of copper, one part.
Stockholm tar, six parts.

FOUNDER.

This disease is not very commonly met with among oxen, and it is in the general way best treated by means of the administration of a cathartic. Cooling applications may be employed locally. If there be any sign of fever, the following draught may be given three times daily :—

Tincture of aconite (V. P.), forty minims.
Spirit of nitrous ether, one fluid ounce
Water, sufficient to make six fluid ounces in all.

GANGRENOUS STOMATITIS.

(i.) Draught—

Chlorate of potassium, two drachms.
Water, six fluid ounces.

This draught may be given four times each day.

(ii.) Gargle—

Tincture of iodine, two fluid drachms.
Water, eight fluid ounces.

This gargle may be employed as often as may be found necessary. The ulcers should be touched with nitrate of silver, or they should be painted over with a mixture of one fluid part of acid solution of nitrate of mercury, and twenty-four fluid parts of water. All the sanitary conditions whereto the animals are subjected should be very carefully attended to.

GARGET.

(*a.*) *In acute stage.*

(i.) Draught—

Bicarbonate of potassium, one ounce.
Tincture of aconite (Gresswell's V. P.), forty minims.
Water, a sufficient quantity.

This draught may be administered every four hours for a day, and then three times daily, so long as the temperature remains high.

(ii.) Draught—

Nitrate of potassium, one ounce.
Tincture of aconite (Gresswell's V. P.), forty minims.

This draught may be given every four hours for a day, and then three times daily, so long as the temperature remains high. In the case of animals affected with this disease, the milk should be removed at regular intervals. Linseed poultices containing two or four drachms of extract of belladonna may be applied.

(*b.*) *In chronic induration.*

(i.) Inject with a lotion made of—

Bicarbonate of potassium, one drachm.
Water, one ounce.

(ii.) In later stage apply acetic liniment. (*See* COUNTER-IRRITANTS.)

(iii.) Draught—

Bicarbonate of potassium, one ounce.
Iodide of potassium, two drachms.
Water, a sufficient quantity.

This draught may be given twice daily.

GLOSSANTHRAX.

(i.) Draught—

Salicylate of sodium, two drachms.
Sulphite of sodium, two drachms.
Water, a sufficient quantity.

This draught may be given four times daily. Treatment is very seldom of any avail, and indeed is only very unfrequently carried out.

(ii.) Gargle—

Acid solution of nitrate of mercury, one fluid drachm.
Water, six fluid ounces.

GLOSSITIS.

(i.) Draught—

Solution of acetate of ammonium] four fluid ounces.
Spirit of nitrous ether, one fluid ounce.
Water, a sufficient quantity.

This draught may be given four times daily. Treatment should be commenced by the administration of sixteen ounces of sulphate of magnesium, or of sulphate of sodium. The animal should be allowed as much gruel as will be taken; and if the power of swallowing is not possessed, nutritive enemata should be given. In the later stages and during recovery the following draught may be administered.

(ii.) Draught—

Gentian, one ounce and a half.
Ginger, half an ounce.
Sulphate of iron, two drachms.

This draught may be given in a pint of warm water twice daily.

GONORRHŒA.

(i.) Draught—

Balsam of copaiva, four ounces.
Castor oil, four fluid ounces.

This draught may be given twice or thrice daily.

(ii.) Draught—

Oleum santali, half a fluid ounce.
Oleum lini, six fluid ounces.

This draught may be given twice daily. Treatment should be commenced by the administration of a cathartic. (*See* CATHARTICS, MILD.)

(iii.) Injection—

Sulpho-carbolate of zinc, five grains.
Water, one fluid ounce.

HÆMATURIA.

Inasmuch as this affection depends on several different causes, being in fact a symptom of various diseases, the treatment of it must of course vary in correspondence with the particular conditions which present themselves in any given case. It is advisable that a laxative should be administered, and as an example we may mention sixteen fluid ounces of castor oil, or sixteen ounces of sulphate of sodium, and so forth. Cold applications to the loins may also prove serviceable.

Draughts—

(i.) Tincture of perchloride of iron, one fluid ounce.
Spirit of chloroform, half a fluid ounce.
Water, a sufficient quantity.

This draught may be administered twice daily.

(ii.) Acetate of lead, one drachm.
Galls, two ounces.
Water, a sufficient quantity.

This draught may be given twice daily.

(iii.) Extract of taraxacum, four ounces.
Carbonate of iron, three drachms.

These substances may be mixed up with a pint of water, and given twice daily.

HÆMORRHAGE. *See* Bleeding.

HÆMORRHOIDS OR PILES.

(i.) Draught—

Extract of taraxacum, four fluid ounces.
Chloride of ammonium, one ounce.
Gentian, one ounce.

This draught may be given once daily in a pint of warm water. Treatment should be commenced by the administration of sixteen ounces of sulphate of sodium, and this cathartic drench may be repeated, when it may be necessary. However, we must remember that in certain cases it may be necessary to use surgical means of cure.

(ii.) Local applications—

(*a.*) Tincture of hamamelis.
(*b.*) Alum, one drachm.
Water, two fluid ounces.

HEEL, ULCERATION OF.

Ointment—

Sulphate of copper, one drachm.
Lard, one ounce.

This ointment may be applied twice daily. Sometimes the granulations are removed by cauterization.

HEMIPLEGIA AND PARAPLEGIA.

(*a.*) *Acute.*

When an ox is paralysed as a result of a tumour or a fracture, the animal should be killed, as there is but little possibility of recovery taking place. If, on the other hand, the paralysis be due to the presence of inflammatory growths, the spine may be blistered by means of ointment of red iodide of mercury, and tonics may be administered internally.

(*b.*) *Chronic.*

Draught—

Liquor strychninæ hydrochloratis, four fluid drachms.
Spirit of chloroform, four fluid drachms.
Water, a sufficient quantity.

This draught may be given twice daily.

HEPATITIS AND CONGESTION OF THE LIVER.

(i.) Laxative draught—

Sulphate of sodium, sixteen ounces.
Caraway seeds, one ounce.

This draught may be given in a pint of warm water, and, if it should be deemed necessary to do so, it may be repeated on the following day. Otherwise one drachm of calomel may be administered instead of the sulphate of sodium, and followed up for several days by half-drachm doses of the same salt. The diet should be small in amount and of a laxative nature.

(ii.) Draught—

Tincture of aconite (Gresswell's V. P.) forty minims.
Chloride of ammonium, six drachms.
Spirit of nitrous ether, one fluid ounce.
Water, a sufficient quantity.

This draught may be given thrice daily, so long as any febrile symptoms are displayed. Afterwards the aconite may be omitted.

HIDE-BOUND.

Draughts and Powders—

The same as those which are mentioned under Anæmia, or as tonics, may be administered. In commencing treatment it is best to give a laxative.

HOVEN. *See* TYMPANITES.

HYDROCELE.

(i.) Draught—

Solution of hydrate of potassium, half a fluid ounce.
Iodide of potassium, two drachms.
Water, a sufficient quantity.

This draught may be given in the drinking water twice daily.

(ii.) Local application.

Tincture of iodine.

HYDROTHORAX. *See* PLEURISY (later stage).

IMPACTION OF THE RUMEN.

Draught—

Sulphate of magnesium, sixteen ounces.
Aloes, eight drachms.
Ginger, half an ounce.
Powdered croton bean, one drachm.

This draught may be given in a pint of warm water. If the bowels do not act, we may administer two pints of castor oil on the following day. If it is absolutely necessary to take that course, the intravenous injection of sulphate of eserine may be tried. (*See* CATHARTICS, VERY STRONG.)

IMPACTION OF THE BOWELS.

Draught—

Sulphate of sodium, sixteen ounces.
Solution of aloes, eight fluid ounces.
Spirit of nitrous ether, one fluid ounce.
Water, a sufficient quantity.

This draught may be repeated in twelve hours' time, if it is found necessary to repeat it. (*See* also CATHARTICS.)

INCONTINENCE OF URINE.

(i.) Draught—

Bicarbonate of sodium, one ounce.
Powdered nux vomica, one drachm.
Ginger, half an ounce.
Gentian, one ounce.

This draught may be given in a pint of warm water twice daily.

(ii.) Draught—

Liquor strychninæ hydrochloratis, two fluid drachms.
Bicarbonate of sodium, one ounce.
Water, a sufficient quantity.

This draught may be given twice daily.

INDIGESTION. (*See* pages 504 to 509.)

Of course our readers will readily understand that indigestion is really a general name given to a great variety of different complaints. For instance, it may on the one hand be due to an excess of acidity in the stomach, and so forth, or it may be owing to a diminution of acidity on the other hand. In the former case draught number (i.) will be best, and in the latter case draught number (ii.). However, in certain cases, alkalies will be necessary, in order to increase the secretion of acid.

(i.) Draught—

Bicarbonate of sodium, two ounces.
Nux vomica, one drachm.
Ginger, half an ounce.
Gentian, one ounce.

This draught may be given in a pint of warm water twice daily. Treatment should, however, be commenced by the administration of a cathartic. (*See* CATHARTICS *a* or *b*).

(ii.) Draught—

Diluted hydrochloric acid, four fluid drachms.
Liquor strychninæ hydrochloratis, two fluid drachms.
Water, a sufficient quantity.

This draught may be given twice daily.

INERTIA OF THE UTERUS (DELAYED PARTURITION).

Draught—

Powdered ergot, one ounce.
Carbonate of ammonium, four drachms.
Gentian, one ounce.
Ginger, half an ounce.

This may be given in a pint of warm water.

INFLAMMATION OF THE BLADDER, BOWELS, BRONCHI, BRAIN, CONJUNCTIVA, CORNEA, KIDNEYS, LIVER, LUNGS, UDDER

(*a.*) *Bladder.*

Draught—

Bicarbonate of potassium, one ounce.
Tincture of opium, one fluid ounce.
Tincture of aconite (V. P.), forty minims.
Water, a sufficient quantity.

This draught may be given thrice daily.

(*b.*) *Bowels.*

Draught—

Tincture of opium, two fluid ounces.
Tincture of aconite (V. P.), forty minims.

This draught may be repeated at intervals of three or four hours.

(*c.*) *Bronchi*, see BRONCHITIS.

(*d.*) *Brain.*

(i.) Draught—

Hydrate of chloral, three drachms.
Bromide of potassium, three drachms.
Water, a sufficient quantity.

This draught may be administered thrice daily. It is advisable to commence treatment with a strong cathartic. (*See* CATHARTICS, STRONG.)

(ii.) Blister. Ointment of cantharides may be applied to the poll.

Powdered cantharides, one part.
Venice turpentine, one part.
Resin, one part.
Palm oil or lard, four parts.

(*e.*) *Conjunctiva.*

(i.) Lotion (to parts around the Eye)—

Boric acid, three grains.
Tincture of opium, ten minims.
Water, one fluid ounce.

(ii.) Lotion (to the Eyeball)—

Sulphate of atropine, two grains.
Water, one fluid ounce.

(*f.*) *Cornea.*

Lotion (to the Eyeball)—

Sulphate of atropine, two to four grains.
Water, one fluid ounce.

A few drops of this lotion may be placed in the corner of the eye.

(*g.*) *Kidneys.*

Draught—

Tincture of aconite (V. P.), forty minims.
Solution of acetate of ammonium, four fluid ounces.
Water, a sufficient quantity.

This draught may be given thrice daily. Warm enemas may be serviceable. and a cathartic (*see* CATHARTICS, STRONG) should be given at the outset. A sheep-skin or some other warm covering placed on the loins has a good effect. Bleeding is sometimes necessary.

(*h.*) *Liver*, see HEPATITIS.

(*i.*) *Lungs.*

(i.) Draught—

Tincture of aconite (V. P.), forty minims.
Solution of acetate of ammonium, four fluid ounces.
Spirit of nitrous ether, half a fluid ounce.
Water, a sufficient quantity.

This draught may be given every six hours.

(ii.) Counter-irritants, *see* COUNTER-IRRITANTS.

(*j.*) *Udder, see* GARGET.

JAUNDICE.

The treatment of jaundice of necessity varies in accordance with the particular case and its causes. The diet should be carefully regulated. The food should be restricted in amount, and of a laxative nature, and capable of being easily digested. In the first instance it is best to begin treatment by the administration of a cathartic (*see* CATHARTICS, STRONG). Perhaps the best cathartic may be composed of—

Sulphate of magnesium, sixteen ounces.
Powdered aloes, eight drachms.
Powdered ginger, half an ounce.

This may be well mixed with a pint or more of warm water or gruel, and then administered.

(i.) Draught—

Chloride of ammonium, four drachms.
Bicarbonate of potassium, one ounce.
Ginger, four drachms.

This draught may be given in a pint of warm water twice daily.

(ii.) Draught—

Diluted nitro-hydrochloric acid, four fluid drachms.
Spirit of chloroform, half one fluid ounce.
Tincture of euonymin, one fluid ounce.
Water, a sufficient quantity.

This draught may be given twice daily in cases of torpidity of the liver.

KIDNEYS, INFLAMMATION OF.

Draught—

Tincture of aconite (V. P.), forty minims.
Solution of acetate of ammonium, four fluid ounces.
Water, a sufficient quantity.

This draught may be given thrice daily. Warm enemas may be beneficial, and a cathartic (*see* CATHARTICS, STRONG) should be given at the outset of the treatment. A sheepskin or other warm covering placed over the loins has a good effect. In certain cases bleeding may be necessary.

LABURNUM POISONING.

Draught (*see* CATHARTICS, STRONG). Perhaps the best may be composed of—

Sulphate of magnesium, sixteen ounces.
Powdered aloes, eight drachms.
Powdered ginger, half an ounce.

This draught may be given well mixed with a pint or more of warm water or gruel.

LARYNGITIS.

(i.) Draught—

Tincture of belladonna, six fluid drachms.
Solution of acetate of ammonium, four fluid ounces.
Water, a sufficient quantity.

This draught may be given thrice daily. Inhalation of steam vapour and the application of counter-irritants to the throat are both necessary. Nutrient enemata should sometimes be given if the animal cannot take a sufficient quantity of food by the mouth.

(ii.) Liniments—

Liniment of cantharides, or liniment of mustard, or that of ammonia, should be applied to the region of the throat. For formulæ *see* COUNTER-IRRITANTS.

(iii.) Gargle—

Tincture of iodine, one fluid part.
Water, twenty fluid parts.

LEUCORRHŒA.

(i.) Draughts—

Those given under the heading of ANÆMIA may be useful. The first of the three mentioned is perhaps the best. It is as follows:—

Powdered gentian, one and a half ounce.
Powdered ginger, half an ounce.
Granulated sulphate of iron, two drachms.
Powdered nux vomica, forty grains.
Powdered capsicum, half a drachm.

This draught may be mixed with a pint of warm water, gruel, or ale, and administered twice daily. This combination of remedies will be found to be an efficient hæmatinic and general tonic. Should the bowels be costive, a laxative should be given. (*See* CATHARTICS, MILD.)

(ii.) Injections—

(1.) Sulpho-carbolate of zinc, two grains.
Water, one fluid ounce.

(2.) Permanganate of potassium, two grains.
Water, one fluid ounce.

(3.) Alum, half a drachm.
Decoction of oak bark, one fluid ounce.

(iii.) Caustic application—

Nitrate of silver may be applied to the ulcerated patches, if there are any present.

LICE.

(i.) Ointment—

White precipitate of mercury, one part.
Lard, twelve parts.

(ii.) Lotions—

(1.) Stavesacre seeds, half an ounce.
Soft soap, two ounces.

The bruised stavesacre seeds should be boiled together with the soft soap in a pint and a half of warm water, until about one pint remains.

(2.) Creosote, three fluid drachms.
Methylated spirit, two fluid ounces.
Water, sufficient to make half a pint in all.

(3.) Tobacco, four drachms.
Hot water, one pint.

(4.) Liquor carbonis detergens, two fluid ounces.
Water, sufficient to make one pint in all.

LIVER, INFLAMMATION OF. *See* HEPATITIS.

LOCKED-JAW.

Draught—

Bromide of potassium, four drachms.
Anise fruit, four drachms.

This draught may be given in warm water or gruel thrice daily.

LUNGS, INFLAMMATION OF.

(i.) Draught—

Tincture of aconite (V. P.), forty minims.
Solution of acetate of ammonium, four fluid ounces.
Spirit of nitrous ether, half a fluid ounce.
Water, a sufficient quantity.

This draught may be administered every six hours.

(ii.) Counter-irritants. *See* COUNTER-IRRITANTS.

In cases of inflammation of the lungs a great deal depends upon the general management. All draughts should be scrupulously avoided, and still the shed should be thoroughly well ventilated. This may, perhaps, best be effected by means of Tobin's tubes. One very good item of treatment may be found in the careful application of hot rugs to the chest.

MALIGNANT CATARRH.

Draught—

Salicylic acid, three drachms.
Tincture of cinchona, two fluid ounces.
Whisky, four fluid ounces.

This draught, which is a most valuable one, may be mixed with a pint of warm gruel and administered at intervals of from four to six hours. However, in spite of treatment, this disease generally proves fatal. The ulcerations may be touched with a preparation made of one part of carbolic acid, in ten parts of either water or oil, and the animal should be made to inhale steam. The diet should be nutritious and of a laxative nature; and if the animal should recover, the administration of tonic medicines will prove necessary.

MAMMITIS. *See* GARGET.

MANGE.

Ointments—

(1.) Sulphur, one ounce.
Lard, one ounce.

This ointment, simple as it is, may be said to be well-nigh invaluable in the treatment of mange in almost all kinds of animals.

(2.) Oil of stavesacre, one fluid drachm.
Lard, one ounce.

This also is a most useful application; perhaps, however, not quite so valuable as the preceding.

(3.) Ointment of sulphur, prepared as above, half an ounce.
Ointment of stavesacre, prepared as above, half a fluid ounce.
White precipitate of mercury, twenty grains.

This, of course, is the strongest preparation of the three.

N.B.—In regard to the treatment and cure of mange, we may make one remark, which applies widely to the management of all cases of disease, whether in animals or in man, although it applies to mange more markedly than to any other malady. It is that a great deal depends on the way in which medicinal preparations are used, and also, of course, on the general management of the affected animals. For example, it is very highly necessary, if we wish to really eradicate mange, that the application should be efficiently used, and used, too, for a sufficient length of time. As a matter of fact, a great amount of careless-

ness is often displayed by human patients. It is no uncommon thing to see how very neglectful men and women are of their own ailments. We certainly, then, can find no cause for wonder that the maladies of lower animals do not receive a sufficient amount of attention. Nevertheless, a great deal of care is necessary, if they are to be cured.

METRO-PERITONITIS, OR PUERPERAL PERITONITIS.

(i.) Draught.

Powdered opium, two drachms.
Salicylic acid, two drachms.
Whisky, six fluid ounces.
Water, a sufficient quantity.

This draught may be given at intervals of six hours. The treatment of this disease should be commenced with the administration of a mild cathartic.

(ii.) Draught.

Salicylate of sodium, four drachms.
Tincture of opium, one and a half fluid ounce.
Solution of acetate of ammonium, four fluid ounces.
Water, a sufficient quantity.

This draught may be administered at intervals of four hours.

(iii.) Injection.

Carbolic acid, half a fluid drachm.
Water, ten fluid ounces.

MILK FEVER. *See* Apoplexy, Parturient.

MUIR ILL. *See* Hæmaturia.

NEPHRITIS. *See* Kidneys, Inflammation of.

ŒSTRUS BOVIS. *See* pages 432 to 436.

It is only necessary to use a small quantity of the ointment of mercury in order to destroy the parasite. A portion of the size of a pea is amply sufficient.

OPHTHALMIA, SIMPLE.

Lotions—

(1.) Sulphate of atropine, two grains.
Water, one fluid ounce.

To be applied to the eyeball.

(2.) Boric acid, three grains.
Water, one fluid ounce.

To be applied to parts around the eye.

OPHTHALMIA, PERIODIC.

Oxen affected with this disease are as a rule killed. If, however, it should be thought best to try remedial measures, a seton or a blister may be applied behind the ear in the case of those oxen which are treated.

(i.) Draught.

Bicarbonate of potassium, one ounce.
Powdered cinchona, one ounce.
Gentian, one ounce.

This draught may be mixed with a pint of warm water and given twice daily.

(ii.) Lotion—

Sulphate of atropine, two to four grains.
Water, one fluid ounce.

PALPITATION.

(i.) Draught—

Tincture of aconite (V. P.), forty minims.
Spirit of chloroform, half a fluid ounce.
Bicarbonate of sodium, one ounce.
Water, a sufficient quantity.

This draught may be given twice daily.

(ii.) Draught—

Sulphate of iron, two drachms.
Digitalis, thirty grains.
Gentian, one ounce.

This draught may be mixed with a pint of warm water, and given twice daily.

PARTURIENT SEPTICÆMIA, PARTURIENT FEVER.

This disease must not be confounded with Parturient Apoplexy.

(i.) Draughts—

(1.) Salicylate of sodium, two drachms.
Brandy, four fluid ounces.

This draught may be given in gruel at intervals of four hours, or the following prescription may be given instead of it.

(2.) Sulphate of quinine, one drachm and a half.
Diluted sulphuric acid, four fluid drachms.
Water, a sufficient quantity.

This draught may be repeated every three or four hours.

(ii.) Injection—

Carbolic acid, two fluid drachms.
Water, ten fluid ounces.

PARTURIENT APOPLEXY. *See* Apoplexy, Parturient.

PEDICULI. *See* Lice.

(i.) Ointment—

White precipitate of mercury, one part.
Lard, twelve parts.

(ii.) Lotion—

Creosote, three fluid drachms.
Methylated spirit, two fluid ounces.
Water, sufficient to make half a pint in all.

PERICARDITIS.

A. Idiopathic.

(*a*) *In early stage.*

(i.) Draught—

Tincture of Aconite (V. P.) forty minims.
Spirit of chloroform, six fluid drachms.
Solution of acetate of ammonium, four fluid ounces.
Water, a sufficient quantity.

This draught may be given every six hours for two or three times.

(ii.) Local application—

The side of the animal may be blistered with ointment of cantharides (lard four pounds, resin four pounds, powdered cantharides one pound). Another very good measure is to apply the hot wet pack.

(*b*) *In later stages.*

Draught—

Carbonate of ammonium, three drachms.
Carbonate of iron, three drachms.

This draught may be given in water twice daily. After an animal has recovered from pericarditis, it is advisable that it should be fattened and killed.

B. Traumatic.

Traumatic pericarditis is generally fatal.

PERITONITIS.

Draught—

Tincture of opium, two fluid ounces.
Tincture of aconite (V. P.), forty minims.
Spirit of chloroform, half a fluid ounce.
Water, a sufficient quantity.

This draught may be given every six hours.

PERITONITIS, PUERPERAL. *See* Metro-Peritonitis.

PHTHISIS PULMONALIS.

Draught—

Cod-liver oil, ten fluid ounces.

This draught may be given twice daily for several days, and then once daily.

PLACENTAL MEMBRANES, RETENTION OF THE.

Draught—

Sulphate of magnesium, sixteen ounces.
Powdered ergot, one ounce.
Carbonate of ammonium, four drachms.

This draught may be given in two pints of warm water, and, if necessary, repeated on the following day.

PILES. *See* Hæmorrhoids.

PLEURO-PNEUMONIA CONTAGIOSA.

This disease is not treated. Preventive inoculation of such animals as have been in contiguity with affected animals has been strongly recommended by some. There is no doubt that immediate slaughter of all animals suffering from this dread disease is necessary. In this connection two questions arise. In the first place, is the flesh of such oxen fit for human food? The answer is a certain and simple negative. It should on no account be consumed. The second question is, Should such animals as have been in contiguity also be slaughtered? The answer to this query is that really they ought to be slaughtered, in order that the disease may be stamped out as soon as possible; but manifestly the pocket is intimately concerned in some of these cases, and hence the decision cannot but be a very difficult one. We believe, however, that the Government has already passed, or, is about to pass, a measure directing that compensation may be allowed in certain instances when it is found

necessary to order slaughter of healthy animals which have been exposed to infection. In case one should be travelling in a foreign country, as for example, in Africa, with a span of oxen, we give two formulæ for this complaint, either of which may be very useful:—

(i.) Carbolic acid, pure, half a fluid drachm.
Cod liver oil, ten fluid ounces.

This draught may be given thrice daily, in a pint and a half of warm water.

(ii.) Salicine, four drachms.
Sulphite of sodium, four to six drachms.
Ginger, half an ounce.
Gentian, one ounce and a half.

This draught may be given, mixed in a pint of ale, twice daily.

PSORIASIS.

(i.) Draught—
Liquor arsenicalis, two fluid drachms.
Bicarbonate of sodium, one ounce.
Water, a pint.

This draught may be given twice daily. A laxative, such as about 14 ounces of sulphate of magnesium, together with half an ounce of powdered ginger, may be given, in a pint of warm water, at the outset of the treatment.

(ii.) Ointment of tar—
Tar, 2½ parts.
Yellow wax, 1 part.

Melt the wax at a low heat, add the tar, and stir the mixture well as it is cooling.

PUERPERAL APOPLEXY. *See* APOPLEXY, PARTURIENT.

PUERPERAL PERITONITIS. *See* METRO-PERITONITIS.

PUPIL OF EYE.

Contractor of,
Lotion—
Sulphate or salicylate of eserine, one to two grains.
Water, one fluid ounce.

Dilator of,
Lotion—
Sulphate of atropine, two to four grains.
Water, one fluid ounce.

PURPURA HÆMORRHAGICA.

(i.) Draught—
Quinetum, one drachm.
Tincture of perchloride of iron, one fluid ounce.
Oil of turpentine, half a fluid ounce.
Water, a sufficient quantity.

This draught may be given twice daily.

(ii.) Draught—
Powdered gentian, one ounce.
Powdered ginger, half an ounce.
Carbonate of ammonium, half an ounce.
Carbonate of iron, two drachms.

This draught may be given twice daily in a pint of warm water, gruel, or ale

PYÆMIA.

Draught—

Powdered cinchona bark, one ounce.

Salicylate of sodium, half an ounce.

These substances may be well mixed with half a pint of warm water and given three times on the first day, and then twice each day. Treatment should be commenced by the administration of a laxative, and tonics will be required during recovery.

PYREXIA. *See* ANTIPYRETICS.

RACHITIS OR RICKETS (in calves).

(i.) Powder—

Phosphate of lime, one and a half to three drachms.

This powder may be given in the food or in milk once regularly every day, or the following may be given:—

(ii.) Draught—

Cod-liver oil, four fluid ounces.

Lime water, two fluid ounces.

This draught may be given once daily. The diet should be of a nutritious nature.

RETENTION OF PLACENTAL MEMBRANES.

Draught—

Sulphate of magnesium, sixteen ounces.

Powdered ergot, one ounce.

Carbonate of ammonium, four drachms.

This draught may be mixed with two pints of warm water, and given once and then again on the next day, if it should be deemed necessary.

RHEUMATISM.

(*a.*) *Acute.*

(i.) Draught—

Tincture of aconite (V. P.), thirty minims.

Salicylate of sodium, four drachms.

Bicarbonate of potassium, one ounce.

Water, a sufficient quantity.

This draught may be given at intervals of six hours.

(ii.) Draught—

Tincture of colchicum, half a fluid ounce.

Tincture of aconite (V. P.), thirty minims.

Bicarbonate of potassium, one ounce.

Water, a sufficient quantity.

This draught may be given at intervals of six hours.

(iii.) Local applications—

(1.) Liniment of belladonna (*see* V. P., page 222).

(2.) Counter-irritants, *see* COUNTER-IRRITANTS.

RINGWORM, ORDINARY (TINEA TONSURANS).

Ointments—

(1.) Ointment of iodine.

(2.) Ointment of acid nitrate of mercury.

(3.) Oleate of copper, one part.

Lard, five parts.

Lotions—

(1.) Sulphurous acid, one fluid drachm.
Glycerine, three fluid drachms.

(2.) Perchloride of mercury, one part.
Water, five hundred parts.

(3.) Acetum cantharidum.

RINGWORM, FAVUS HONEYCOMB (ACHORION SCHÖNLEINII).

The same treatment as that for the ordinary ringworm given above.

SCARLATINA.

Draught—

Solution of acetate of ammonium, four fluid ounces.
Spirit of nitrous ether, one fluid ounce.
Bicarbonate of potassium, half an ounce.
Water sufficient to make eight fluid ounces.

This draught may be given thrice daily.

SCOUR OR SKIT. *See* DIARRHŒA.

SCROFULA.

Draught—

Phosphate of lime, two drachms.
Sulphate of iron, one drachm.
Gentian, one and a half ounces.

This draught may be given in warm water twice daily.

SORE TEATS.

Ointment of boric acid.

Melt four parts of soft paraffin and two parts of hard paraffin together, and add one part of boric acid in fine powder, distributing it over the surface of the liquid by passing it through a sieve. Then keep on stirring the mixture until it is cold. This ointment is wonderfully efficacious.

SPLENIC APOPLEXY, OR SPLENIC FEVER. *See* ANTHRAX.

Draught—

Sulphite of sodium, three drachms.
Salicylate of sodium, three drachms.
Water, half to one pint.

This draught may be given every four hours.

SPRAINS.

In the early stages a cooling lotion is useful, and for a suitable formula the following may be taken :—

Solution of subacetate of lead, one fluid ounce.
Methylated spirit, two fluid ounces.
Water sufficient to make sixteen fluid ounces: or *see* COOLING LOTIONS.

In the later stages it is advisable to apply a stimulating embrocation or some suitable counter-irritant.

STINGS.

Lotion—

Carbolic acid, one fluid part.
Glycerine, one fluid part.

STOMATITIS. *See* Gangrenous Stomatitis.

STRANGURY. *See* Hæmaturia.

TABES MESENTERICA.

Draughts—

(1.) Sulphate of iron, two drachms.
Creasote, one fluid drachm.
Gentian, one ounce.
Ginger, one ounce.

This draught may be mixed with a pint of warm gruel and administered twice daily.

(2.) Cod-liver oil, ten fluid ounces.
Oil of eucalyptus, ten minims.

This draught may be given twice daily.

TETANUS, OR LOCK-JAW.

Draught—

Bromide of potassium, four drachms.
Anise fruit, four drachms.

This draught may be mixed with warm water or gruel, and given thrice daily.

THRUSH IN THE MOUTH. *See* Aphtha.

TONGUE, ACTINOMYCOSIS OF. *See* Actinomycosis.

Tonics, *see* Anæmia.

Draught—Powdered gentian, one ounce.
Powdered ginger, half an ounce.
Carbonate of ammonium, half an ounce.
Carbonate of iron, two drachms.

This draught may be given twice daily in a pint of warm water, gruel, or ale.

TYMPANITES, OR HOVEN.

Treatment of this malady should begin with the administration of a cathartic.

(i.) Draught—

Hyposulphite of sodium, half an ounce.
Water, a sufficient quantity.

This draught may be given at intervals of from two to four hours for several times.

(ii.) Draught—

Ether, two fluid ounces.
Carbonate of ammonium, half an ounce.
Spirit of chloroform, one fluid ounce.
Water, a sufficient quantity.

This draught may be given at intervals of four hours.

(iii.) Draught—

Sulphocarbolate of sodium, half an ounce.
Bromide of potassium, two drachms.
Chlorodyne, six fluid drachms.
Water, a sufficient quantity.

This draught may be given at intervals of from four to six hours.

UDDER, INFLAMMATION OF. *See* Garget.

URTICARIA.

Draught—

Bicarbonate of potassium, half an ounce.
Bicarbonate of sodium, half an ounce.
Nitrate of potassium, half an ounce.
Water, a sufficient quantity.

This draught may be given twice daily.

VACCINIA.

Draught—

Solution of acetate of ammonium, four fluid ounces.
Tincture of aconite (V. P.), forty minims.
Water, a sufficient quantity.

This draught may be given three times daily. A laxative should be administered in the first instance, and the milk should be drawn off by a syphon.

WARBLE. *See* Œstrus Bovis.

WHITES. *See* Leucorrhœa.

YEW-TREE POISONING.

In the first place a cathartic should be given, and this should be followed up with the following draught:—

Carbonate of ammonium, three drachms.
Whisky, four fluid ounces.
Gruel, sufficient to make half a pint in all.

This draught may be repeated at intervals of four or five hours.

CHAPTER VIII.

CONCLUSION.

EVEN as all things sooner or later must come to an end—for even "kings and queens and princes must, like all men else, soon come to dust"—so at length we have, after some labour, arrived at the close of our task. When we concluded our series of articles on "The Diseases and Disorders of the Ox" in the *Yorkshire Weekly Post* we wrote as follows :—

"At the instant when our kind and indulgent readers shall be glancing their eyes upon these words, this eventful year of grace, 1887, in which so much has happened that will bring forth its abundance of fruit in the future, this year, in which Her Majesty's Jubilee has been celebrated with so much splendour and rejoicing, will be rapidly ebbing away further and further, while its last few remaining sands fall down and sink for ever into the bottomless gulf of the past.

"And now; as we conclude our review of 'The Diseases and Disorders of the Ox,' it is with a twofold feeling that we do so ; for while on the one hand we cannot but feel glad—we say it in all modesty—to think that we have done and completed some arduous work which can never be altogether lost, on the other we do realise that the subject is one even as yet in its infancy, and one in regard to which our successors in the future will doubtless devote much earnest attention to the no small benefit of mankind in many most important ways, the chief of which is the light which bovine pathology will throw upon the diseases of human beings. We have done our best in the past year to give the latest and the most reliable information in regard

to the diseases of the ox, and we hope in the first half of 1888 to achieve at least an equal degree of success in reference to those of the sheep, an animal whose health and wants should be specially looked to by the sheep-owner.

"We have received at various times kind words from our readers, and we may say that we do feel very pleased and grateful to think that we have been able to carry through a lengthy series on a difficult subject to the satisfaction of many. To those who may wish to continue their acquaintance with our work in book-form, we take this opportunity of stating that we have entered into an arrangement with Messrs. William H. Allen & Co., 13, Waterloo Place, Pall Mall, S.W., to write a treatise on the Ox, and that the articles which have appeared from our pen in this year's *Yorkshire Weekly Post* will, after a thorough amplification and revision, be included in this copiously illustrated manual. We hope to have this completed as early as possible in the ensuing year, and ready perhaps for the spring publishing season.*

"Emboldened by the kindness and attention with which our articles have been received, we have engaged to contribute for the first half of the year, 1888, which begins to-morrow, a clear and succinct account of 'The Diseases and Disorders of the Sheep,' which we hope will be no less popular among farmers and the community generally than our two previous series. We shall to-day take the liberty, in some sense by way of conclusion, of turning aside to a matter of great national importance, concerning which we propose to say a few words.

"In the *Times* of Tuesday, December 13, 1887, a paragraph appears under the title of 'A Gloomy Agricultural Outlook in the North,' wherefrom we gather that in the vast grazing district constituted by Cumberland and Westmoreland there are upwards of 50,000 acres untenanted, and that affairs are becoming more critical every day. In the hill districts, where the land drains rapidly, the crops have been exceedingly light. In the fell dales some farmers are already buying hay, and the majority hardly see their way through the winter. Moreover, the great northern hiring fairs have just been held, and very many able-bodied men and women have failed to find places.

* Some portions of our work occupied us so long that this expectation turned out to be quite out of the question.

"Unfortunately we may add to this bad news that other parts are also likely to suffer some amount of distress, and there are people who say that this winter may not improbably be the worst which England has ever seen. All this points to a state of things which may be spoken of as nothing less than disastrous, and any hint which may help matters cannot be thrown away. Now the fact is that in these days there are far too many of us who are apt to be forgetful of the advantages of many kinds, but especially in the way of health and strength, to be derived from rural pursuits. The tendency of modern civilisation leads to our congregating more and more closely into the larger towns, and no doubt there are great facilities connected with an urban residence.

"Still there is the other side of the shield to be looked at, as the old fable of the town mouse and the country mouse so forcibly reminds us; and there is not the least doubt that it is time that we should pay more heed to the fact that active exercise in the open country is a great desideratum. There are too few persons who fully realise the very great benefits accruing from out-of-door pursuits. It is true that hunting, shooting, fishing, and so forth, have each and all their eager votaries; but the point we would lay stress on is that one of the greatest boons connected with the avocation of farming is one that is often lost sight of—we mean the essential healthiness of agricultural pursuits and operations. This aspect of the question is one which, if thoroughly appreciated, might lead to the taking up of all the farms which are now to be let in the country, quite eagerly and without delay.

"There is no doubt that there are many people well able to put their energies into farming who, even if they did not become very affluent by so doing, might at least secure a fair return for time and money expended, and, what is far more than this, might increase in a most material way not only their happiness, but also their strength, their health, and the duration of their lives. In this connection it is to be borne in mind that it is always darkest ere the dawn, and that things may unhesitatingly be now looked upon as being at their worst. As matters now stand, there is no disputing that the country districts, depending, as they do, rather largely on their own unaided resources, are in a bad way. Further, although it is a long lane which has no turning, we

must not expect that when we pass round the corner, as we are doing even now, that things will all at once become very, very bright.

"Looking at the question purely from the monetary point of view, we cannot but see that the actual productions of the soil probably must, in the very nature of things, fetch a less price, just in proportion to the progress of universal civilisation throughout the world at large, and the ever-increasing facilities for communication and transit. In so far as these benefits lead to a lack of cultivation of the land in England, they are, we all hope, to be looked upon as transitory. The re-action must come soon, and in emphasising the good accruing to the bodily frame of man from the active and regular habits necessarily characteristic of agricultural pursuits, we are striving to show what splendid chances now offer themselves to those possessing the necessary means and qualifications.

"It is a grievous error made by very many people, that they do not do enough actual physical work in the open air. Men and women are becoming too much like hot-house plants, which cannot bear to be taken out into the fresh air. There are far too many of us who are utterly ignorant of the beautiful sights which are never very far distant from us, even when we are 'cribbed, cabined, and confined' in some boxed-up corner of a huge city. The railways well-nigh annihilate space, and places which but a little time ago were inaccessible, except to the rich, are now open to almost all. The greatest pleasures in life are to be gained by active employment of some kind or other among the wondrous beauties of the rural scenes existing all around us, replete with the harmonious symphonies of nature.

"There can be no doubt that the close confinement so generally associated with our modern pursuits in these days is, in point of fact, to be looked upon as nothing less than a disastrous national calamity. The spirit of *indoorism*, and that of another gigantic evil, *examinationism*, if we may be allowed to use the two expressions, are grievous and crying errors, which should be remedied at almost any cost. It is high time that the re-action should set in against examinations, and the pernicious practices of overwork and cramming thereby engendered. There are far too many examinations now-a-days, and they are working an incalculable amount of harm, a degree of mischief which can

never be fully realised, because it is of the nature of those evils which cannot be in any adequate manner estimated.

"There is no greater, and, unfortunately, no more general mistake than that habit which many, of even the strongest of us—it is often necessary in the case of the weak and debilitated—have, namely, that of shutting ourselves up in our warm and comfortable houses, and scarcely ever stepping foot outside. No words can adequately express how dreadfully wrong it is for healthy people thus to immure themselves, as so many do, in what may almost be spoken of as veritable prisons, however luxurious may be the mansions so persistently occupied. The great secret of health, or one of the great secrets of that most desirable and enjoyable state—at least for healthy people—is to go out and see the world itself as it really is, and not as men have made it, and breathe the pure air of heaven, and listen to the songs of the birds, it may be, or perhaps to the richly-modulated music of the sea.

"It is a very mistaken idea, that the Government of a country should exercise direct control in spheres which ought to lie quite outside Governmental influence. We refer more especially to the management of railways and other enterprises of a commercial character.

"Mr. James Bryce, M.P., in the *Contemporary Review* for June, 1884, defines a University as 'a body of men engaged in teaching the highest knowledge.' On the primary necessity of its teaching services, as opposed to its examining and degree-conferring powers, he justly lays the most marked emphasis. The highest aim of a University should be by direct teaching to impart that stimulating impulse which disposes us to apply such knowledge of facts, principles, and methods as we possess to the best possible account. All branches of knowledge ought to be recognised, and all comers ought to be admitted to any of the courses of instruction carried on. Examinations are to be regarded rather as necessary evils rather than as indispensable and all-important adjuncts of the work of a University; and when examinations become the chief controlling influences, dictating peremptorily exactly what portions of a subject shall be taught, they are liable to become excessively mischievous and most misleading. First-rate teaching can go on, and often has gone on, in the absence of formal examinations. Not only, then,

should it be our aim to train doctors, surgeons, teachers, lawyers, engineers, clergymen, statesmen, and men of business; but, above all, we should never forget the primary importance of producing the philosophic habit of mind, and the possession of all those great principles which co-ordinate the various branches of knowledge. The indispensable necessity of this will be sufficiently obvious when we reflect that even a single man, endowed with a correct and accurate understanding, may affect the entire course of thought, and at the same time modify the whole current of events for a generation or more.

"'The ideal University will be that whose own comprehensiveness is best reflected in the catholicity of its students' views, its elevation in their enthusiasm, its freedom in the variety of their conditions and pursuits.

"'In these days of wealth, luxury, ease, and pleasure, the truer happiness offered by the study of Nature and the Muses should be made accessible to those who cannot or do not wish to enter for protracted courses of study. Nor is it the less requisite to endeavour, by rendering the more abstruse subjects popularly interesting, to enable the masses to rise from poverty, unenlightenment, distress, and misery. The principle applies alike to the uncultured rich and to the uncivilised poor. For the ensuring a healthy public opinion, and, consequently, the best form of government, there is required more education for the rich and also for the needy. The spirit of philosophy thus invoked and obtained would do much to guard us against the application of crude and violent legislative remedies against evils ingrained in human nature and society by the mere force of circumstances. In so far as Universities foster such a spirit, and effect the establishment of a high standard of culture among us, all must perceive how great is their value to a nation, and how earnestly we should desire their progress to a still wider and more potent influence.'

"Whatever ideas we may entertain as to the knowledge which may be gained in the dim and distant future by mankind; however, we may in our own minds answer the question whether the human beings which will be evolved in coming ages will or will not be able to cope successfully with the wonderful mysteries involved by the fact of man's existence in this world; at any rate there is one point respecting the possibilities open to us which

admits of no doubt in the minds of those who, while looking at the present and towards the future by the help of the light of past history, cannot but see clearly that a great advance has been and is being made in our powers over the external world.

"Not for a moment need we hesitate to admit that those who will live after us will know very much more than we now can even dream of; and just in the same proportion as human knowledge extends its boundaries, so also will human power widen its sphere of action. The age in which we are living has been most abundantly fertile in discoveries, and as yet even those men who are most intimately familiar with these discoveries are unable to appreciate the full value and significance of them, nor can they realise the great rewards open to future and perhaps still more patient and persevering workers, for whom these modern and new inventions will serve as keys and clues.

"Of all the adages current among us there is none more true than the trite one which assures us that 'Nothing succeeds like success'; there is none which is so true of human progress in so many different ways. The young and earnest investigator of these days stands upon a vantage ground of immeasurable value. He is so incalculably ahead of his predecessors that he may be said in great measure to start where they left off. Of course, it is only partially true that any beginner can commence where those who went before him have finished; for in some measure at least all human beings must submit themselves to the same severe training in order to reach any degree of excellence. Yet the path of progress has been cleared of many most formidable obstacles, and it has been marked out, so to say, in advance, so that pioneers need not lose themselves in impenetrable jungles of sophistry which lead far away from the truth, fog the intellectual powers, and obscure the shrewdness and clear perspicacity of even the deepest thinkers and searchers. A great deal of what may be termed the initial rough work has been done; the results of this are fairly easily attainable, may, in fact, be gathered up by stretching out the hands, can be grasped and utilised with but very small efforts, as compared with those originally put forth to obtain them by those toilers who first secured them for the benefit of struggling humanity.

"This more or less direct means of benefit is, however, by no

means the only way in which modern workers are helped in their work. The greater the degree to which social division of labour has advanced, the greater is the help which each individual receives from all. The reverse view is frequently held, for it is often thought that in these days of keen competition and rivalry it is harder to do good work than in more easy-going times and less advanced communities. Only a little reflection, however, is needed to prove that this view is a very erroneous and narrow one. The pinch of competition, the stress of threatened poverty and destitution, is by no means without its good side. There is no doubt that the actual necessity of continued application will, other things being equal, evoke the very best and the most patient and enduring work. True, there are some men and women who do excellent work without the strain of pressure; but these people are exceptions, and perhaps even they would do still more perfectly, and would put forth still greater efforts, if the future did not seem to them quite so assured as it does. Indeed, the threatenings of uncertainty in regard to their future cannot but act as powerful stimulants to all men, though of course they affect different people in different ways and to varying extents.

"It is very questionable, indeed, if the doubtful advantages of wealth and worldly grandeur are in reality much better than the beauteous mirages of some sandy desert, of delusions which are as transient and as fleeting as the splendid colouring of a rainbow, or the bright iridescence of a dewdrop glistening on the petals of a lily in the fresh morning air. Many of the so-called pleasures of the fashionable world are as empty as a soap-bubble when compared with the happiness of any human being, no matter how insignificant, who has learned to know truth, is conscious of no wrong-doing to his fellow-men, but rather of continued efforts in their behalf and for their good. Such delight as springs from such attempts as these is indeed priceless, and far exceeds in value and in sustained strength the costliest treasures of all the cities of the world. The channels into which human energies can be directed are innumerable, and any person who selects any given sphere of work may in these days receive help almost boundless in amount, compared with what was formerly available.

"The motive power, so to say, of a civilisation as high as that existing around us is incalculably immense, and in order

to reap the powerful impetus of this almost spontaneous impulse only one thing is necessary—the doing of excellent work, the finding out or the application of some great benefit to the human race at large. So far from it being true that there is less chance now than formerly for those who are down to rise up, the very reverse of this is the case; for in these days there is always what may almost be called a ravenous demand for all that really partakes of the very highest and best. This applies not to this or to that activity only, but to every manner of workmanship known among mankind.

"It is to be remembered that there is very much going on around him which escapes the notice of the most observant, most regular, most careful, and most painstaking man, much that, up to the present, has escaped the searching gaze of all men. It is this which we in these days have to look for, and see how we are helped in our scrutiny; note the multitudinous ways, many of which every now and again we quite forget or ignore, in which we may help ourselves and aid our efforts. Do we feel ill, weak, incapable of work? Do we need a change? Look at the wonderful appliances which our fellow-men eagerly thrust before us! Splendid hotels ploughing calmly over the boundless and beautiful ocean, carefully managed hydropathic establishments in England, Scotland, Germany, and elsewhere, picturesque seaside resorts, all these things and numberless others are ready for us, nay, eagerly await our advent. Innumerable are the appliances of science to keep the breath of healthy life in our bodies. In short, such and so numerous are the chances of advancement open to us that we may well conclude that each man is now-a-days even more markedly than in past times the architect of his own fortune or misfortune.

"The suitable and right training of the young, of those who are destined to play parts more or less prominent in the business of a community, the fostering of a spirit of true culture and intelligence, the formation of that philosophic habit of mind invariably resulting from a liberal and sound education and from a course of wide reading, coupled with the habit of accurate observation—these are not the least among the primary duties of mankind. In fact, the subject of education is one which yields to no other in importance. It may be said, indeed, that to train our children correctly comes second in point of urgency

only to the necessity of providing them with the requisites of healthy life.

"Whether we hold that the Government of a country should employ direct means to secure the right bringing up and care of the minds as well as the bodies of the young, and, if so, what the nature and extent of that direct method should be, or whether, on the other hand, we are disposed to believe that the governing powers should not directly interpose and interfere, all must agree that one great aim of every nation should be to foster to the utmost the spirit of culture and research.

"This being so, those who are practically engaged in the work of education feel that they are right in asking for, and even, we will add, justified in demanding, the interest and influence of all.

"The great differences of opinion on this subject of training, and the widely divergent views of those who have had years and years of practical experience in teaching, constitute sufficient evidence that men have at least been convinced that there are still presented for solution major and minor problems of the greatest difficulty. Indeed, it needs but little exemplification to show that much advance must still be made in our methods of tuition, and especially is there need for light in the choice of subjects and parts of subjects to be taught, in order that there may be the least possible expenditure of time and labour and friction in bringing about a knowledge of the most essential principles, and the chief facts which support such principles, on the part of the pupils. It has been insisted that it should not be our object to lessen the difficulties encountered in the process of learning. Only a little consideration, however, is needed to show how erroneous this view is. It is doubtless true that facts which have been easily learned place the learner on a vantage ground, the importance of which he is apt to under-rate. Yet we must remember that this argument would apply to every one born at this epoch, inasmuch as we are all "heirs of past ages." It would obviously be impossible for us to realise, even in a dim degree, the labour that has been done for us by our progenitors. Further, they, too, had advantages bequeathed to them in like manner, and, unless they had possessed them, recent discoveries could not have been made. To those who are sanguine and optimistic in their views—and it is one of the best signs of the times that men are holding up their heads with firm

and determined will at this time of temporary yet most severe depression, despite the reiterated doctrines of pessimism—it will ever be manifest that, however great have been the deeds done in the past, their magnitude and importance are as nothing when compared with the discoveries which await us. Realising this, they will never stint any and every aid which they can supply to those who are about to carry forward the same great work in which they are themselves so nobly engaged, and they will also try to atone for the slight loss which may here and there perchance result from what may appear to be a too easy learning of principles and facts which they, the teachers, had necessarily greater difficulty in acquiring, by instilling even more of that enthusiasm and love of the work and of the truth than they themselves were always able to keep up. It must be clear that, when those difficulties which are avoidable have been cleared from the path of the travellers, they will journey onwards with a lighter heart and a freer step, and a greater power of removing those obstacles which still stand so firmly, and so mockingly embarrass man's best and most enduring efforts. For the workers of this and the next generation there are many thorny thickets to be battled with and cut down with the sharp and keen axe of the human intellect, aided in every possible way that striving men can devise. If this applies to the cultured worker, how much more does it affect our conceptions regarding the teaching of the young!

"That there is very much room for improvement in current methods and ideas relating to the great subject of education of all classes and degrees of students, men seem to be universally agreed. Above all things it is a most serious question if we are right in these days in giving such decided preference to the study of language, the organized embodiment of the symbols of our thoughts, or whether we should not rather, in the first place, impart instruction respecting those realities which underlie words, the mere counters and representatives of things and of thoughts. Surely, on reflection, it would rather be decided that, inasmuch as words are, at best, but very imperfect modes of expressing the things symbolised by them, the study of Nature herself should be our primary and chief object. We ought, so far as is possible, to have recourse to the study of natural phenomena and natural objects themselves, to Nature's true

coins, unadulterated and undefiled. With this point in view, we ought to consider it a duty of paramount importance to reiterate and ensure, so far as our power will extend, that physical science, the most important and yet most neglected of all studies, should be efficiently and intelligently and practically taught in every educational institution, both to female and male students. We would lay stress on the word *taught* as opposed to the principle of examination, since there can be but little doubt that examinations, when carried to excess, so far from encouraging original research, probably do more than any other necessary evil to retard and deaden and prevent real and living interest on the part of the students of this generation.

"Mr. Ruskin * says 'that the maximum of life can only be reached by the maximum of virtue'; and in order to attain the maximum of virtue it is clear that education is essential, not only for the training of the mind into nobler channels, but for the dissipation of the crude superstitions and empirical doctrines of bygone ages—doctrines which narrow the range of thought and stifle true scientific inquiry.

"In saying, then, that there is only a minority of people who realise the facilities existing around them, we are not referring so much to the immense benefits conferred upon each and all who live in this century of advancement. No doubt that fact in itself is a very great source of help, but we are now desirous of laying stress on the more primary pleasures of the active life of bodily exercise, and on the practically illimitable resources of nature which, so far from appreciating as we ought, many of us in these days are becoming more and more forgetful of. The difficulties in life, despite our very excellent means of transport, arise largely from our immobility. The average human being finds himself or herself in a certain place, and, strange to say, very often experiences great aversion to a change of residence. A great deal of misery springs from the fact that the right man or woman frequently cannot find the right place.

"For instance, in our colonies there is room for all those who cannot succeed in England; but two obstacles to setting matters right are, first, the actual steps necessary to secure the transit across the seas; and, secondly, getting suitable employment

* *Ad valorem.*

when landed afresh in the new country far away from friends and help. There is, in fact, an exceptional amount of anxiety and wretchedness threatening us just now. It is really a dreadful state of things when there are strong men and women, all eager and ready for work, who cannot find employment, and the worst of it is seen by considering, if this is so in the country, how much more pitiful will be the distress existing in the back streets of our large towns in this coming winter. The actual necessaries of life are so very cheap in agricultural districts that the facts we have alluded to are, from some points of view, worse; but, on the whole, of course much better than at first sight they may seem to be.

"All those who help the seething masses of humanity to extricate themselves from the depths of degradation, in which so many are sinking and daily being swallowed up, are doing a great and a noble work. All those who are trying to do this are scattering seed which will bring forth fruit after many days. This good can only be achieved by appealing to the higher sentiments and feelings, which, fortunately, are probably never quite extinguished, even in the most hardened criminals and evil-doers. We must try to elevate them with the spirit of aspiration, and with feelings of enthusiasm for higher and better things, and we must not think that much enduring good can ever be brought about by our having recourse to the harsh and hard lines of action too often laid down. In short, pity and mercy and help will affect far more than severe measures of punishment and unfeeling and unpitying recrimination.

"And now all that remains for us is to wish everybody, and especially our readers, each and all—as we most cordially do—the happiest of happy new years, a new lease of healthy and joyous life and prosperity, and all the good and pleasant things that this world and this stage of earthly existence can bring, and the surety of higher blessings in that unknown sphere which lies beyond the grave."

We have above reproduced more or less exactly the words we used on the occasion referred to, and now all that remains for us to add is that since then Time has rolled on his unceasingly-revolving wheel, and we have therefore been enabled to forge just a few more links of the chain of pathology and to incorporate them in this book. We are very conscious of its short-

comings ; but still we cannot but think that we have advanced a little way up the steep and arduous hill of science. So intensely important is the subject we have dealt with, that even if we have achieved but a little, it is still something which can never be lost ; and may God grant that good to the struggling striving human race may come of even our humble work—good not only to this man or to that man, or to that afflicted woman or child only, but to all—to each and all ; for who cannot see that the benefit of all is productive of advantage to each individual ? One thing, happily, can safely be affirmed, and that is, that agriculture is in a better way now than formerly—nay, more, who can doubt that its seeming backward flow was merely apparent, and not real, merely a temporary phase. The recent agricultural depression has probably been due chiefly to bad seasons. With better seasons we shall doubtless have a great revival. Who cannot see that oftentimes many of the worst evils are ultimately productive of good ? For those struggling ones who fall in the meantime during the distressful and dark days—be well assured He receiveth them into His eternal rest, where they are blessed for ever, and suffer no more ?

APPENDIX.

FURTHER REMARKS ON THE COMMUNICATION OF SCARLET FEVER FROM MILK TO HUMAN BEINGS.

In the *Times* of April 22nd appears a leading article, of which we here append an abstract :—

The report of the Medical Officer of the Local Government Board for the year 1887 contains the results of further investigations concerning the nature of the disease in cows to which outbreaks of human scarlet fever have been attributed. Until two or three years ago. it was thought that the power of milk to spread the disease was due to its having been contaminated from human sources, especially by the agency of persons who were themselves suffering or convalescent from scarlet fever, and who, nevertheless, were engaged in the work of distribution.

However, in the case of a milk epidemic which occurred at Hendon, in 1885 to 1886, and in which the hypothesis that the carriers might be sources of infection could be definitely set aside, the cows which yielded the incriminated milk were found to be the subjects of an eruptive disease of a contagious character. The introduction of this disease could be clearly traced to certain new arrivals, and the milk of the diseased animals was that which had been consumed by the human victims of the epidemic.

Accordingly, it was ordered that the milk yielded by these animals should be thrown away ; but it appears that the men employed in the dairy thought this proceeding wasteful, disobeyed their orders, and gave the milk to some poor families. The result was that the children of these families were affected with scarlet fever in an aggravated form.

This kind of evidence having been thoroughly sifted by Mr. Power, the further investigation of the subject was committed to Dr. Klein, who obtained certain micrococci from the milk and tissues of the diseased animals, and cultivated them on suitable media, and conducted inoculation experiments upon animals with the cultures and sub-cultures thus obtained.

In August 1887, the Medical Officer of the Local Government Board was able to sum up the results of the investigation, by saying that the disease, whether in man or cow, was characterised by closely similar anatomical features ; that from the diseased tissues and organs, of man and cow alike, the same micrococcus could be separated, and artificial sub-cultures be made from it ; and that these sub-cultures, no matter whether from man or cow, possessed the property, when inoculated into calves, of producing in them every manifestation of the Hendon disease, except sore teats and udders ; this exception being probably due to the fact that the milk-apparatus in calves is still undeveloped. The practical

lessons to be learned from these conclusions are that the eruptive diseases of cows should be studied with the greatest care, and that all milk should always be boiled before being consumed by human beings.

In the report just issued, Dr. Klein shows that the sub-cultures from human scarlatina, inoculated into cows which have recently calved, can produce in those cows, along with other manifestations of the Hendon disease, the characteristic ulcers on the teats—ulcers seemingly identical with those observed at the Hendon farm. Moreover, the sub-cultures, established either from the human or the cow disease, have the same property of produciug in various rodents a disease similar in its pathological manifestations to the Hendon disease of cows and to scarlatina in human beings. Calves fed on sub-cultures established from human scarlatina obtain the Hendon disease; and children fed on milk from cows suffering from the Hendon disease became affected with scarlatina. It is, therefore, clear that the Hendon disease is a form, occurring in the cow, of that which we call scarlatina when it occurs in human beings.

In the course of the inquiry, some difficulty was occasioned by the appearance, at a farm in Wiltshire, of an eruptive malady in cows which was at first supposed to be identical with that which had been observed at Hendon, but with which no scarlet fever was associated; and also by an outbreak of sore-throat at Edinburgh, among the consumers of the milk furnished by a particular dairy. The cows in this dairy had an eruptive disease of the teats and udders; but the sore-throat which followed the use of their milk could not be recognised as either scarlatinal or diphtheritic; and, on one of the cows being sent to Dr. Klein, the disease, although inoculable into calves, and presenting affinities with the Hendon disease, was yet found to be clearly distinguishable from the latter by certain differences with regard to the progress of each, by the condition of certain organs after death, and by the inoculability of one or the other into rodents; differences, in short, which led Dr. Klein to the conclusion that this Edinburgh cow-disease is not the same as cow-scarlatina. With regard to the Wiltshire outbreak, the same observer finds that this also, although attended by a somewhat similar eruption, differs from the Hendon disease in almost every other character, and appears to bear no kind of relation to scarlatina.

The identification of many different maladies accompanied with eruptions in cows may be most hopefully attempted by a study of the forms of bacterial life which are associated with each different disease.

These bacteria are of the kind called "streptococci," so-named on account of their tendency to unite together in chains; and Dr. Buchanan points out that there is as little difference, to the less educated judgment, between one and another chain-forming micrococcus as, to the eye of the ordinary dweller in towns, exists between the swift, the swallow, and the martin. Dr. Klein formulates seven sets of characters, serving to distinguish between one and another organism of the group. Hence the application of seven tests is required before an assertion of the identity of any two streptococci can, even provisionally, be made. In a special report on the various streptococci, Dr. Klein refers to nine varieties, which do not include all the members of the class which he believes to possess distinguishing characteristics of their own; and he shows that some at least of these differ widely, not only in the characters which he points out, but also in the effects which they produce when introduced into the animal body by inoculation or by swallowing. The minute care which has been bestowed upon these researches is almost beyond praise, and should convey an instructive lesson with regard to the extreme difficulty of conducting them.

INDEX.

A.

D.

E.

F.

G.

H.

I.

N.

O.

P.

Q.

R.

S.

T.

U.

V.

W.

FINIS.

10/1902